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THE EDENTATA OF NORTH AMERICA.

BY E. D. COPE.

NORTH America has possessed during late Cænozoic times a limited number of species of Edentata, which have been outliers of the great horde which has peopled South America since the Eocene.

This order embraces two suborders, whose characters were first noticed by Flower,[1] and whose names were given by Gill.[2]

Mutual articulations of posterior dorsal and lumbar vertebræ normal; *Nomarthra.*

Posterior dorsal and lumbar vertebræ with episphen and zygantrapophyses which bear articular surfaces; *Xenarthra.*

Of these divisions it is evident that the Nomarthra are the least specialized, and must be regarded as ancestral to the Xenarthra. Neither of the living families of Nomarthra can, however, claim this position, as they are too specialized in various parts of their structure. They are now exclusively Old World, while the Xenarthra are confined to the New World. The families are distinguished as follows:

NOMARTHRA.

No dermal scuta; teeth, each composed of parallel dental elements; *Orycteropodidæ.*

Body covered with corneous scuta; no teeth; *Manidæ.*

[1] Osteology of the Mammalia, 1870, p. 55.

[2] Standard Natural History, 1884, p. 66.

XENARTHRA.

Astragalus and calcaneum elongate; latter without trochlea; no dermal bones; unguiculate; teeth (sloths);	*Bradypodidæ.*
Astragalus and calcaneum short, former with trochlea; unguiculate; teeth; no dermal bones;	*Megatheriidæ.*
Astragalus short, with trochlea; on dermal bones; unguiculate; no teeth (anteaters);	*Myrmecophagidæ.*
Astragalus short, with trochlea; a carapace of dermal bones; subunguiculate; teeth simple (armadillos);	*Dasypodidæ*
Astragalus short, with trochlea; a carapace of dermal bones; posterior feet ungulate; teeth sculptured by vertical grooves;	*Glyptodontidæ.*

Common ancestors of the Nomarthra and Xenarthra are unknown. But few extinct representatives of the Nomarthra are known.[3] A Manis has been obtained in the Sivaliks of India, and a genus Palæomanis (Forsyth Major) from the Miocene beds of the island of Samos in the Grecian Archipelago. The *P. gigantea* is three times as large as the largest existing species. The same locality has yielded a species of Orycteropus.

The existing forms of the Xenarthra appear to be widely separated from each other, but paleontological discovery has greatly narrowed the intervals between them, so that the homogeneity of the order is certain. Thus the Megatheriidæ are equally allied to the ant-eaters, the sloths, and the armadillos, and such genera as Nothropus and Chlamydotherium connect these with the Glyptodons. The carapace is rudimental in genera both of Glyptodontidæ and Megatheriidæ. The Megatheriidæ also indicate a point of contact with other orders of

[3] The *Pangolin gigantesque* of Cuvier, was referred to a genus Macrotherium by Lartet, and allied forms have been placed in a genus Ancylotherium in Europe and Moropus in America. Macrotherium turns out from the researches of Filhol to have no definite relation to the Edentata, and to be founded on the foot-bones of Chalicotherium. Chalicotherium must be then widely distinguished from the Perissodactyla, where it has been placed. I have proposed a new order, the Ancylopoda, to receive it. See Osborn in AMERICAN NATURALIST, 1888, p. 758, and Cope, l. c. 1889, p. 153.

mammals, as M. Ameghino has discovered some extinct genera from the Parana, in which the teeth possess a narrow band of enamel. The connection is to the Bunotheria, which were probably the ancestors of the Edentata.

The Megatheriidæ are probably the ancestors of both the Bradypodidæ and the Myrmecophagidæ. The modification of the tarsus characteristic of the former is probably due to the assumption of the habit of suspension from limbs of trees by the ancestors of the sloths. This is not only probable from the mechanics of the case, where support on the ground has been followed by suspension below a branch, but also by the analogy of the bats. In these animals, as Dr. H. Allen has pointed out, the similar habit of suspension has produced in the hind limb a similiar modification of the forms of the astragalus and calcaneum.

The Megatheriidæ embrace a large variety of genera, all extinct, and nearly all restricted to the Neotropical Realm. They embrace mostly species of large size, though there is much variation in dimensions. They differ in the number of digits, and the extent to which progression was accomplished on the external edge or sole of the foot. They are also distinguished into Mylomorpha and Rodimorpha (Ameghino), the former having a homogeneous molar dentition, the latter having the anterior tooth in each jaw developed into a canine-like form and function. These types graduate into each other through the genera Mylodon and Lestodon, but not so completely as to destroy the diagnostic value of the character. The genera may be then distinguished as follows:

I. Mylomorpha.

a Molar teeth $\frac{4}{3}$.

Molars with two cross-crests; *Cælodon* Lund.

aa Molar teeth $\frac{4}{4}$.

Molars with cross-crests; *Ocnobates* Cope.[4]

Molars not ridged; nasal bones connected with premaxillary spine; *Grypotherium* Reinh.

[4] Orocanthus, Ameghino; preoccupied.

aaa Molars $\frac{5}{4}$.

Molars with two cross-crests;	*Megatherium* Cuv.
Molars simple; last not elongate;	*Scelidotherium* Owen.
Molars simple; last elongate, grooved;	*Mylodon* Owen.

II. Rodimorpha.

a Molar teeth $\frac{5}{4}$.

Molars with two cross-crests;	*Pliomorphus* Amegh.
Molars simple, last elongate;	*Lestodon* Gerv.
Molars simple, none elongate, canines widely separated; claws compressed;	*Megalonyx* Jeff.
Molars simple; canines close together;	*Diodomus* Ameg.

Besides these, there are several genera described by M. Ameghino, of which the characters are not yet accessible to me. Thus Promegatherium[5] differs from Megatherium by the presence of a band of enamel on the inner side of the molar teeth, but the number of these is unknown. Promylodon[6] Amegh. differs from Mylodon in the same way, but here also the number of these teeth, and other characters, are unknown.

The genera of this family known to occur in North America are Megatherium, Mylodon, and Megalonyx. Of the first, a single species, *M. mirabile* Leidy, is known. It was a large animal, exceeding the Indian Rhinoceros in dimensions. Its remains have been found as yet only in the Pliocene of the Southern States. Mylodon is represented by two species, *M. laqueatus* Harlan, from the eastern region of the continent as far north as Pennsylvania, and *M. sodalis* Cope (Fig. 1), from the Pliocene beds of Oregon. Both were large animals, not smaller than an ox in dimensions. Megalonyx is represented by a larger number of species. The *M. jeffersonii* Cuvier has a geographical range nearly equal to that of the *Mylodon laqueatus*, while another species (Plate XXXI.) has been only found in the Ticholeptus formation of Kansas. In Pennsylvania the bone caves have yielded the teeth of *M. loxodon* Cope, *M. dissimilis* Leidy, and *M. tortulus* Cope.

[5] Bol. Acad. Nac. Cienc. Cordova, 1883, p. 293.

[6] Bollet. Acad. Nac. de la Cienc., Cordova, 1886, p. 184.

These huge beasts were all vegetable feeders, living on the foliage of the trees which they uprooted, or whose branches they

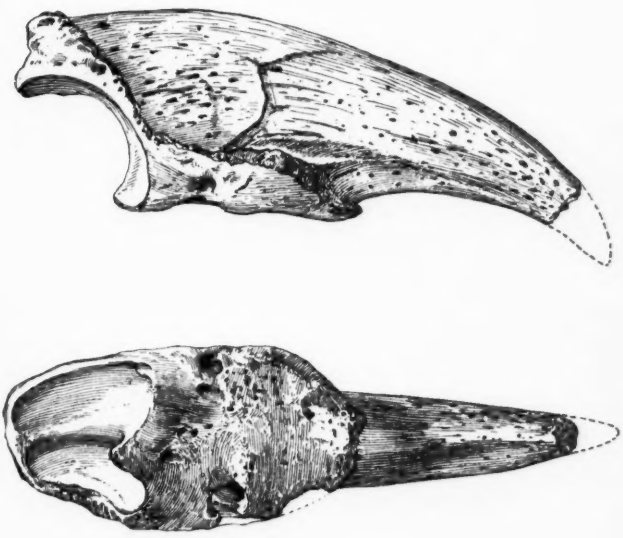


FIG. 1.

could reach. They are of late arrival in North America, and two genera, Megatherium and Mylodon, are each represented by species which persisted to or even into the period of human occupation.

In the Myrmecophagidæ, the terrestrial habit has been retained, but the disuse of the teeth, following the habit of swallowing ants whole in saliva, has resulted in their loss. Corresponding habits and loss of teeth are seen in the Old World Manidæ. No extinct species are known.

The ancestors of the Glyptodontidæ from the Miocene of the Parana, like those of the Megatheriidæ from the same region, possess narrow bands of enamel on the teeth. This discovery, made by Ameghino, confirms the anticipation expressed by

myself,[7] that the Edentata are descended from mammalia with enamel-covered teeth. Such forms as the Tæniodonta of the North American Eocene correspond to such a type. These animals were armed with the powerful fodient claws, and the texture of their bones was much like that of Edentata. The enamel is much reduced on the adjacent faces of the teeth.

Ancestral forms of some of the families have been found in the upper Miocene (Loup Fork) beds of North America. The *Caryoderma snovianum* Cope, from Kansas, was a Glyptodont with partially developed carapace, consisting of osseous nodules. (Plate XXXII.) The plates covering the tail were better ossified, apparently forming rings of acuminate tuberosities as in the genus Hoplophorus. Hoofs of a similar form, from Texas, are described by Leidy. The genus Glyptodon extended its range to North America during Pliocene time. A species was abundant in the valley of Mexico at that period, and specimens of probably the same from southwestern Texas and Florida have furnished the basis of our knowledge of the *G. petaliferus* Cope. (Fig. 2.) Leidy has described a still larger species (*G. floridanus*) from the state after which it is named.

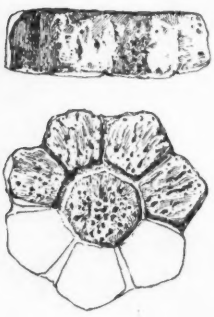


FIG. 2.

The genera of the family may be defined as follows:

I. Teeth with two internal and two external ribs.

Last two molars prismatic; grinding faces plane; *Nothropus* Burm.

II. Teeth with two internal and three external ribs. Tail with distinct rings.

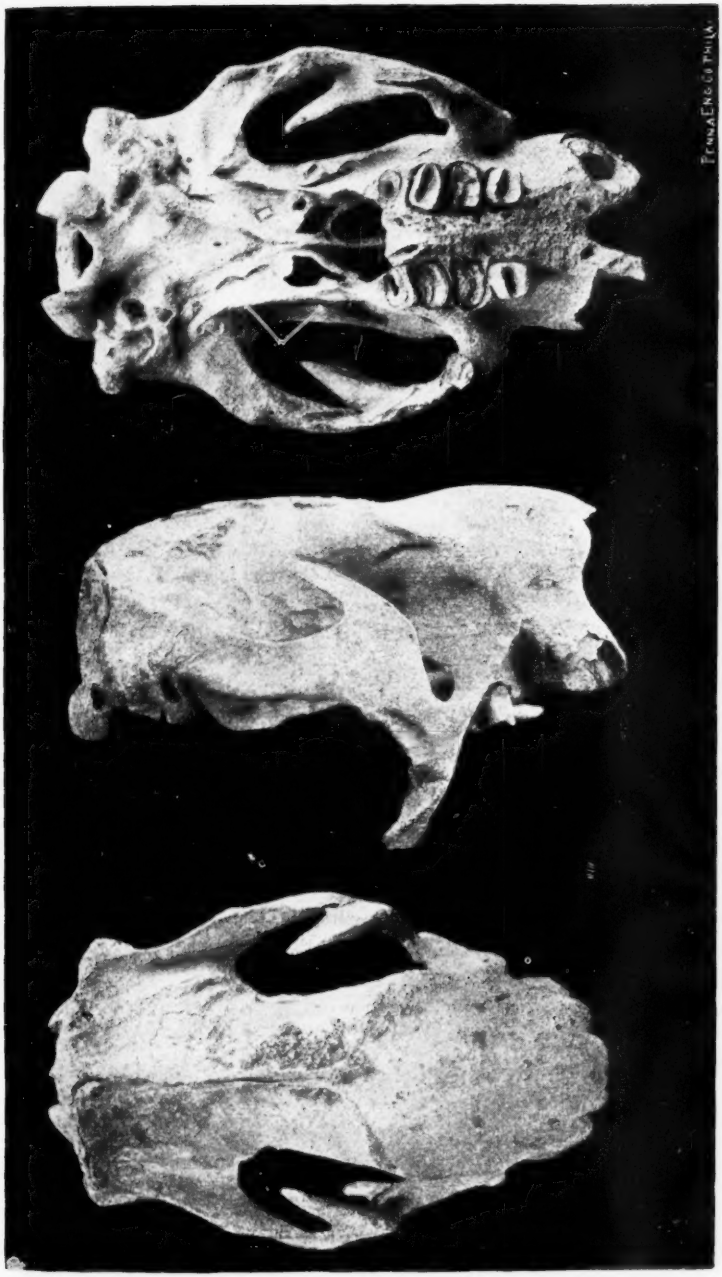
Scuta of carapace nodular; (? teeth)[8] *Caryoderma* Cope.

Scuta of carapace quadrate; *Chlamydotherium* Lund.

[7] U. S. G. G. Surv. W. of 100th Mer., 1887, p. 158; AMERICAN NATURALIST, 1885, p. 352.

[8] Teeth unknown.

PLATE XXXI.



SKULL OF MEGALONYX.

III. Teeth with three internal and three external ribs.

a Tail, with distinct rings, and without terminal tube.

Digits 5-4; *Glyptodon* Owen.

aa Distal and longer part of tail enclosed in an osseous tube.

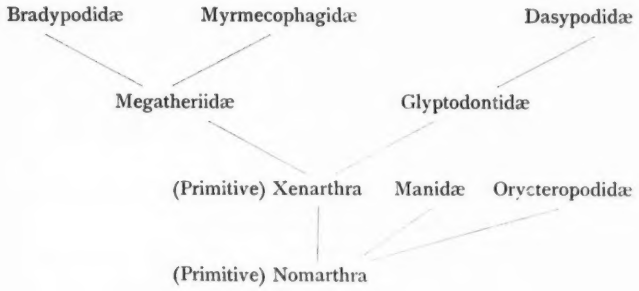
Digits 3-4; tail probably spinous; *Dædicurus* Burm.
Digits? Caudal tube compressed, and with enlarged lateral tubercles; *Euryurus* Gerv. and Am.
Digits 4-4; *Hoplophorus* Lund.

The species of these genera are of various dimensions. *Caryoderma snovianum* (Plate XXXII.) was about the size of a glutton or catamount, while *Chlamydotherium gigas* was nearly equal in size to a rhinoceros. The *C. humboldtii* and various species of Glyptodon and Hoplophorus might be compared to the *Tapirus americanus*. *Dædicurus clavicaudatus* Owen reached a length of twelve feet, according to Burmeister, and its massive spinous tail was an efficient weapon. *Hoplophorus tuberculatus* Owen is said to be as large as a rhinoceros. It can be seen how greatly their existing descendants, the armadillos, have diminished in size, as well as simplified the forms of their teeth.

It is probable that the Dasypodidæ are descendants of the Glyptodontidæ by a reduction of the complexity and increase in number of the teeth. The posterior ungual phalanges of fœtal armadillos are, according to von Ihring, ungulate and trilobate, as in Glyptodontidæ. Extinct species of Dasypodidæ occur in the later Cænozoic beds of South America, most of which belong to existing genera. The principal extinct genus known is Eutatus Gerv. which usually resembles Tatusia, but has five digits on all the feet instead of four. Several species are known.

Much remains to be learned about the phylogeny of this

order. The present phase of the subject may be represented as follows:



EXPLANATION OF PLATE XXXI.

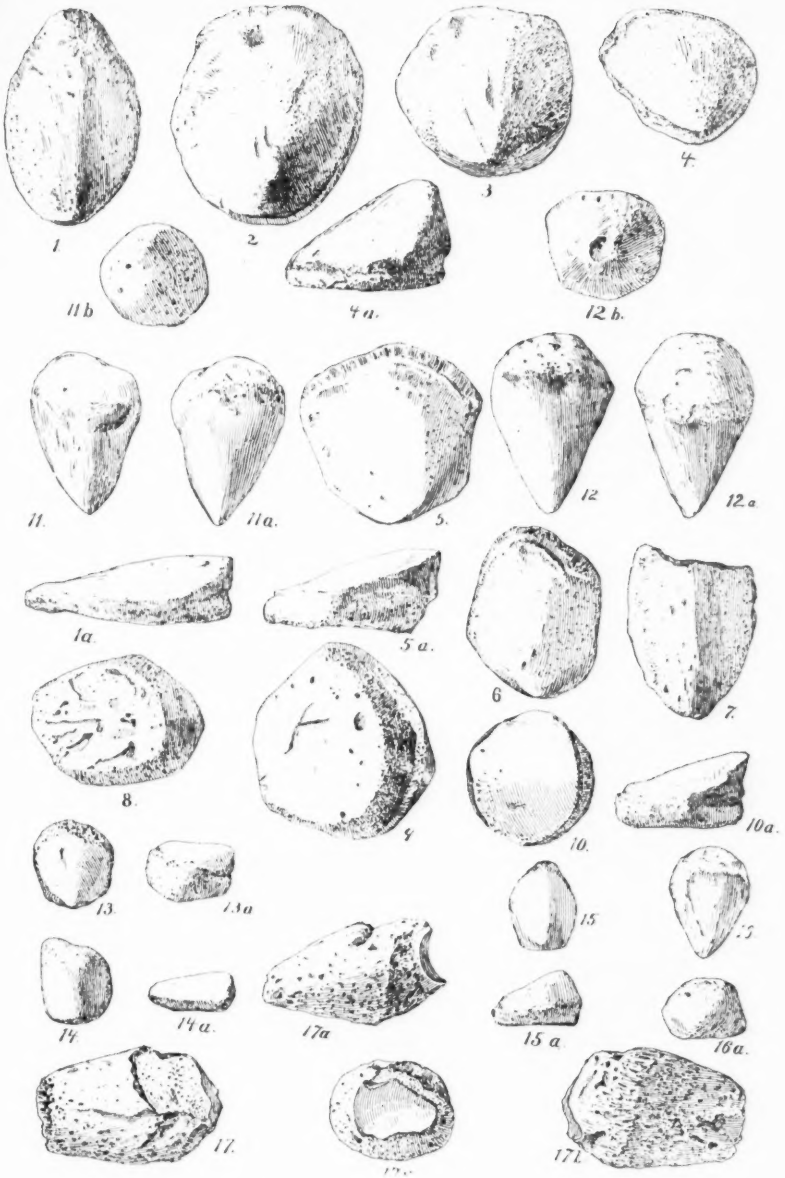
Three views of the skull of a species of Megalonyx.

EXPLANATION OF PLATE XXXII.

FIGS. 1—16. Dermal bones of *Caryoderma snovianum* Cope, natural size.

FIG. 17. Ungual phalange of do.

PLATE XXXII.



Caryoderma snovianum Cope.

HISTORY OF GARDEN VEGETABLES.

BY E. L. STURTEVANT.

(Continued from p. 987, Vol. 1888.)

LIMA BEAN, *Phaseolus lunatus* L.

THIS bean is of American origin, as its seed has been found in the mummy pits of Peru,[1] and Bentham cites specimens spontaneous in the region of the River Amazon and Central Brazil.[2] Thevetus, in 1558, published his "Les Singularities de la France Antarctique ou Amerique," and in this he speaks of the "Americanorum Faba, omnino alba, valde compressæ, nostratibus latiores et longiores," which is probably this species. The striæ radiating from the eye of the Lima bean make its identification very easy, and hence we cannot be in error in our recognition of the figures given by Lobel[3] in 1591, Clusius[4] in 1601, J. Bauhin[5] in 1651, and Chabræus[6] in 1673, and Clusius notes that he first grew it in 1576.

The synonymy, as I have studied it out, is as follows:

Phaseoli magni late albi. Lob. Ic., 1591, 2, 60.

B. peregrini I. genus alterrum. Clus. Hist., 1601, 2, 223 (seen in 1576) fig.

Phascolus, lato, striata, sive radiato semine. J. Bauh., 1651, II., 267, fig.

P. novi orbis, latus, totus candidus similaci hortensis affinis. J. B., 1651, II., 268, fig. Chabr., 1673, 137, fig.

Phaseolus lunatus, L. sp., 1763, 1016.

P. inamœnus, L. sp., 1763, 1016.

P. bipunctatus. Jac. Hort., I., t. 100, ex Mill. Dict.

P. rufus. Jacq. Hort., I., 13, t. 34, ex Mill. Dict.

P. saccharatus. Macfad., 1837, 282.

P. puberulus. Kunth. Syn., 1825, IV., 106.

Bushel or Sugar Bean. A Treat. on Gard. (1818[?]).

[1] Squiers. Peru, 78.

[2] Decandolle. Orig. des Cult. Pl., 276.

[3] Lobel. Ic., 1591, 2, 60.

[4] Clusius. Hist., 1601, 223.

[5] J. Bauhin. 1651, II., 268.

[6] Chabræus. Ic. et Sciag., 1673, 137.

Sugar Bean. Maycock, Barb., 1830, 293.

Lima Bean. McMahon, 1806.

This bean requires a warm season, and hence is not grown so much in northern and central Europe as in this country. Vilmorin[7] describes three varieties and names two others. Martens,[8] however, describes five well marked varieties.

1. The *large white Lima* is among those figured by Lobel[10] and by J. Bauhin,[11] and this places its appearance in Europe in 1591, and according to Martens it is the *Phaseolus inamœnus* L. It was in American gardens[9] in 1828, and probably before.

2. The *potato Lima* is a white bean, much thickened and rounded as compared with the first. It seems to be fairly figured by Lobel[10] in 1591, and to be the *Phaseolus limensis* Macfad.[12] justly esteemed in Jamaica.

3. The *small white Lima*, or *Sieva*, *saba*, *Carolina*, *Carolina sewee* and *West Indian*, is esteemed on account of its greater hardiness over the other varieties. It is also well figured by Lobel in 1591, under the name Phaseoli parvi pallido-albi ex America delati. On account of the names, and the hardiness of the plant, and as being probably cultivated by the Indians, I am disposed to suggest that it may be the Bushel or Sugar bean, esteemed very delicate, and of various colors, as white, marbled, and green, and grown in Virginian gardens before 1818.[13] Lawson[14] in 1700–8 says: "The Bushel bean, a spontaneous growth, very flat, white, and mottled with a purple figure, was trained on poles" in the Carolinas. The Sieva, if a synonym of the Bushel bean, is the white form, and was in American gardens before 1806. Vilmorin mentions a variety of the Sieva spotted with red.

4. The *speckled Lima* has white seeds striped and spotted with a deep, dark red. The figures of Lobel, 1591, under *Phaseoli rubri*, very well represent the cultivated variety, as also a sort sent

[7] Vilmorin. Les Pl. Pot., 1883, 278.

[8] Martens. Die Gartenbohn, 1869, 96.

[9] Fessenden. New Am. Gard., 1828, 36.

[10] Lobel. Ic., 1591, 260.

[11] J. Bauhin. Hist., 1651, II., 168.

[12] Macfadyen. Jam., 1837, 280.

[13] A Treatise on Gardening; by a Citizen of Va., n. d., 275.

[14] Lawson. A Voyage to Carolina, 76, 77.

me as growing spontaneously in Florida in abandoned Indian fields.

5. The *large red* I cannot trace; it may be the blood red bean Martens received from Texas, Sierra Leone and Batavia. It differs from the next but in size.

6. The *small red* answers well to the description given of *Phaseolus rufus* Jacq. by Martens, and this put its appearance at 1770.

These six varieties, with their synonyms, include all the Lima beans with which I am acquainted, but there are a number of other sorts described, which sooner or later will appear and be claimed as originations. A careful reflection over my list will clearly convince that our varieties are all of ancient occurrence, and that there have been no originations under culture within modern times. A black white-streaked form is recorded in Cochin China by Loureiro; a white black-streaked form is figured by Clusius in 1601; a black as *Phaseolus derasus*, Schrank, in Brazil. The *P. bipunctatus* Jacq. has not as yet reached our seedsmen, although grown at Reunion under the name of pois du Cap. Martens describes several others with a yellow band about the eye, and variously colored, and one with an orange ground and black markings occurs among the beans from the Peruvian graves at Ancon at the National Museum.

The Lima bean is called in India[15] the *Duffin* or *Vellore bean;* in Jamaica[16] the *Sugar bean*, as also in Barbadoes.[17] In France, *Haricot de Lima, feve creole;* in Germany, *Lima bohne;* in Italy, *Faguiolo di Lima;* in Spain, *India de Lima;*[18] in Ceylon, *oorudumbala.*[19]

LOVAGE. *Ligusticum levisticum* L.

This plant is yet to be rarely found in gardens. At the present day, says Vilmorin, Lovage is almost exclusively used in the manufacture of confectionery; formerly the leaf stalks and bottoms of the stems were eaten, blanched like celery.[20] The whole

[15] Ainslie. Mat. Med., I., 28.
[16] Macfadyen, l. c.
[17] Maycock, Fl. Barb., 293.
[18] Vilmorin, l. c.
[19] Birdwood. Veg. Prod. of Bomb., 122.
[20] Vilmorin. The Veg. Gard., 1885, 316.

plant has a strong, sweetish, aromatic odor, and a warm, pungent taste, and is probably grown now in America, as in 1806, rather as a medicinal than as a culinary herb. It appears to have been known to Ruellius [21] in 1536, who calls it *Levisticum officinarum*, and was only seen in gardens by Chabræus [22] in 1677.

It is called in France *ache de montagne, liveche ;* in Germany, *liebstock ;* in Spain, *apio de monte.*[22]

MALLOWS. *Malva crispa* L.

This plant is considered nearly indispensable in French gardens, although it is not an esculent, but the leaves are used for garnishing.[23] It was known to Camerarius[24] in 1588, and was only known to Dodonæus,[25] in 1616, as a cultivated plant. The mallows which were used by the Romans as a pot-herb appear to be the *Malva rotundifolia* L. Even Pythagoras thought much of this spinage, and it is even now said to be grown extensively on the banks of the Nile. *M. sylvestris* L. appears also to have been grown by the Romans as a pot herb, and *M. verticillata* L. has been recognized among Chinese vegetables from the 5th century. All these, and, indeed, all malvas have now disappeared from cultivation as edibles in European countries.

The Curled Mallow is called in France *mauve frisée, mauve crepue, mauve à feuilles crispées ;* in Germany, *krausblättrige malve ;* in Italy, *malva crespa.*

The *M. rotundifolia* L. was carried to North America previous to 1669, and now appears as a weed. It is the *mallows* of Britain and America, the *mauve* of France, the *runde kasepappel* of Germany, the *malva* of Italy, the *moloha* or *molohe* of Greece. In Yemen called *hobsen.*[26]

The *M. verticillata* L. is called in Egypt *khobbeyzeh ;* in China *tung han ts'ai.*[27]

[21] Ruellius. De Nat. Stirp., 698.

[22] Chabræus. Icones et Sciag., 1677, 401.

[23] Vilmorin. The Veg. Gard., 319.

[24] Camerarius. Hort., 1588.

[25] Dodonæus. Pempt., 1616, 653.

[26] Pickering. Ch. Hist., 348.

[27] Gard. Chron., July 10, 1886, 41.

MANGOLD. *Beta vulgaris*, var.

Mangolt was the old German name for the Chard, or rather for the beet species, but in recent times it has become applied to a large growing root of the beet kind, used for forage purposes. In the selections size and the perfection of the root above ground have been important elements, as well as the desire for novelty, and hence we have a large number of very distinct appearing sorts,—the long red, about two-thirds above ground, the olive shaped or oval, the globe, and the flat-bottomed Yellow d'Obendorf. The colors to be noted are the red, the yellow, and the white. The size often obtained in single specimens is enormous; a weight of 135 pounds[28] has been claimed in California, and Gasparin in France vouches for a root weighing 132 pounds.[29]

I have ascertained very little concerning the history of mangolds. They certainly are of modern introduction. Olivier de Serres[30] in France, 1629, describes a red beet which was cultivated for cattle-feeding, and speaks of it as a recent acquisition from Italy. In England it is said to have arrived from Metz[31] in 1786, but I find a book advertised of which the following is the title:—Culture and use of the Mangel Wurzel, a Root of Scarcity, translated from the French of the Abbe de Commerell, by J. C. Lettsom, with colored plates, third edition, 1787,[32]—by which it would appear that it was known earlier. McMahon[33] records it in American culture in 1806. Vilmorin describes sixteen kinds, and mentions many others.

The beet is one of the plants most easy to improve by selection, as the experience of Vilmorin proves, as well as the more perfected varieties which are constantly being advertised. I doubt not but that the prototypes of all the distinct forms could be found in nature, but unfortunately I find no descriptions which I

[28] U. S. Department of Agriculture Report, 1866, 597.

[29] Pr. Es. H. Soc., 3rd Ser., IX., 258, note.

[30] Decandolle. Geog. Bot., 831.

[31] Sinclair. Hort. Gram., Woburn, 1824, 410.

[32] Wesley. Nat. Hist. Book Circular, No. 71, 1886.

[33] McMahon. Am. Gard. Cal., 1806, 187.

can use to illustrate this idea, which receives such constant support with other plants whenever facilities for investigation occur.

The *mangold, mangold-wurzel* or *Root of Scarcity* is called in France *Disette, Racine d'abondance, Betterave Disette;* in Germany, *mangel-worzel, futter-rube, futter-runklerube;* Flanders and Holland, *mangel-wortel;* in Spain *remolacha de grav cultivo, betabel campestu.*

MARTYNIA. *Martynia*, sp.

The fruits of the Martynias, when gathered while young and tender, make an excellent pickle, and they are occasionally grown in our gardens for this purpose. There are two species.

M. proboscidea Glox. This purple-flowered form occurs wild on the banks of the Mississippi and lower tributaries to New Mexico. It is also cultivated in gardens further north, about which it is apt to become naturalized.[34] It is mentioned under American cultivation in 1841.[35] It was known in England as a plant of ornament in 1738,[36] and perhaps there has scarcely as yet entered the kitchen garden.

M. lutea Lindl. This species, originally from Brazil, has yellow flowers.[37] It does not appear to be in American gardens, as I have never seen it, nor is its seed advertised by our seedsmen. It reached Europe in 1824.[38] It is described by Vilmorin as under kitchen garden culture.

The Martynia, or Unicorn plant,[39] is called in France *martynia, cornaret, cornes du diable, bicorne, ongles du diable;* in Germany, *gemsenhorner;*[37] in Italy, *testa di quaglia;*[40] in Malta, *testa di quaglia.*[36]

MEADOW CABBAGE. *Cirsium oleraceum* Scop.

This plant is included among vegetables by Vilmorin,[41] although he says it does not appear to be ever cultivated. The swollen

[34] Gray. Syn. Flora, II., 321.
[35] Kenrick. New Am. Orchard, 3d ed., 1841, appendix.
[36] Gard. Chron., 1843, 608.
[37] Vilmorin. Les Pl. Pot., 329.
[38] Noisette. Man., 1829, 537.
[39] Burr. Field and Gard. Veg., 1863, 612.
[40] A Smith. Treas. of Bot.
[41] Vilmorin. Les Pl. Pot., 1883, 157; The Veg. Gard., 1885, 321.

root-stock, gathered before the plant flowered, was formerly used as a table vegetable. It does not appear to have ever reached American gardens or use.

MELON. *Cucumis melo* L.

Both the word *melon* and *pepon* have been used in a generic sense, and sometimes as synonymous. Albertus Magnus,[42] in the thirteenth century, says, *melons*, which some call *pepones*, have the seed and the flower very nearly like those of the cucumber, and also says in speaking of the cucumber that the seeds are like those of the *pepo*. Under the head of the watermelon, *citrullus*, he calls it *pepo*, with a smooth, green skin, but the *pepo* is commonly yellow and of an uneven surface, and as if round semicircular sections were orderly arranged together. In 1536 Reullius[43] describes our melon as the *pepo;* in 1542 Fuchsius[44] describes the *melon*, but figures it under the name of *pepo*. In 1550 Roszlin[45] figures the melon under the name of *pepo*, and in 1558 Matthiolus[46] figures it under the name of *melon*. The Greek name of *pepon*, and the Italian, German, Spanish, and French of *melon*, variously spelled, are given among synonyms by various authors[47] of the sixteenth century, and *melones* sive *pepones* are used by Pinæus in 1561,[47] *melone* and *pepone* by Castor Durante[48] in 1617, and by Gerarde[49] in England, in 1597. *Melons* and *pompions* are used synonymously, and the melon is called *muske-melon* or *million*.

Whether the ancients knew the melon is a mattter of doubt. Dioscorides,[50] in the first century, says the flesh or pulp (cara) of the *pepo* used in food is diuretic. Pliny,[51] about the same period, says a new form of cucumber has lately appeared in Campania called *melopepo*, which grows on the ground in a round form, and he adds, as a remarkable circumstance, in addition to their color

[42] Albertus Magnus. De Veg., Jessen ed., 1867, 501.

[43] Ruellius. De Nat. Stirp., 1536, 503.

[44] Fuchsius. De Stirp., 1542, 702, 701.

[45] Roszlin. Kreuterb., 1550, 116.

[46] Matthiolus. Com., 1558, 262.

[47] Pinæus. Hist., 1561, 194. Camerarius Epit., 1586, 296, etc.

[48] Castor Durante. Herb., 1617, 345.

[49] Gerarde. Herb., 1597, 775, 770.

[50] Dioscorides. Vergelius trans., 1532, 219.

[51] Plinv, Lib. XIX., c. 23.

and odor, that when ripe, although not suspended, yet the fruit separates from the stem at maturity. Galen,[52] in the second century, treating of medicinal properties, says the autumn fruit [*i.e.*, ripe] do not excite vomiting as do the unripe, and further says mankind abstain from the inner flesh of the *pepo*, where the seed is borne, but eat it in the *melopepo*. A half century later Palladius[53] gives directions for planting *melones*, and speaks of them as being sweet and odorous. Apicius,[54] a writer on cookery, about 230 A. D., directs that *pepones* and *melones* be served with various spices corresponding in part to present customs; and Nonnius, an author of the sixth century, speaks of cucumbers which are odoriferous.[55] In the seventh century Paulus Ægineta,[56] a medical writer, mentions the medicinal properties of the *melopepo* as being of the same character, but less than that of the *pepo*, and separates these from the *cucurbita* and *cucumis*, not differing from Galen, already quoted.

From these remarks concerning odor and sweetness, which particularly apply to our melon, and the mention of the falling spontaneously of the ripe fruit, a characteristic of no other garden vegetable, we are inclined to believe that these references are to the melon, and more especially so as the authors of the sixteenth and following centuries make mention of many varieties, as Amatus Lusitanus,[57] in 1554, who says, "*quorum varietas ingens est*," and proceeds to mention some as thin skinned, others as thicker skinned, some red fleshed, others white.

I know scarcely enough about melons as yet to classify into types, as I am only acquainted with fifty-eight names of varieties under growth, but varieties occur that can be described as round, flattened, oblong, oval, long; as smooth, netted, ribbed, warted; as white, green, red, orange fleshed; as early, late, and winter.

The following may be considered as notes only; not as com-

[52] Galen. De Alim., Lib. II.; Gregorius ed., 1547, 97.

[53] Palladius, Lib. IV., c. 9; Lib. V., c. 3; Lib. VI., c. 15.

[54] Apicius Cœlius. De Opsonibus, etc., Amsterdam, 1709, 82.

[55] Nonnius. Quoted from Lister in Apulius, l. c.

[56] Paulus Ægineta. De Simp., 1531, 76.

[57] Amatus Lusitanus. In Diosc., 1554, 265.

plete classification, nor even as any classification, and a single and the earlier reference is in most cases only used.

1. Early and late melons, as also winter melons, are described by Amatus[00] in 1554; summer and winter by Bauhin[57] in 1623.

2. White and red fleshed are described by Amatus in 1554; yellow fleshed by Dodonæus in 1616; green fleshed by Marcgrav[62] in 1648; green, golden, pale yellow, and ashen, by Bauhin[57] in 1623.

3. Sugar melons are named *sucrinos* by Ruellius[58] in 1536; *succrades rouges* and *succrades blanches* by Chabræus[59] in 1677; and *succrius* and *succredes* by Dalechampius[60] in 1587.

4. Netted melons are named by Camerarius[63] in 1586, as also the ribbed. The warted are mentioned in the Adversaria[64] in 1570; rough, warted, and smooth by Bauhin[57] in 1623.

5. The round, long, oval, and pear-form by Gerarde[65] in 1597; the quince form by Dalechampius[66] in 1587; the oblong by Dodonæus in 1616; the round, oblong, depressed, or flat by Bauhin[57] in 1623.

The quality of melons varies widely, even in the same variety, under different conditions of growth, as was well known in 1513, when a Spanish author, Herrera,[67] says, "If the melon is good, it is the best fruit that exists, and none other is preferable to it. If it is bad, it is a bad thing. We are wont to say that the good are like good women, and the bad like bad women."

The melon reached America nearly with the discovery, for in 1494 ripe *melons* are recorded as grown by the companions of Columbus.[68] In 1516 "*melons* different from those here" are mentioned in Central America,[69] but perhaps not the melon, but a cucurbit. In 1535, however, Cartier[70] speaks of "*musk melons*"

[00] Amatus Lusitanus. In Diosc., 1554, 265.
[57] Bauhin. Pinax, 1623, 310, 311.
[58] Ruellius, l. c.
[59] Chabræus. Ic. et Sciag., 1677, 134.
[60] Hist. Gen., Lugd., 1587, 623.
[61] Dodonæus. Pempt., 1616, 664.
[62] Marcgrav. Bras., 1648, 22.
[63] Camerarius. Epit., 1586, 296.
[64] Pena and Lobel. Adv., 1570, 285.
[65] Gerarde, l. c.
[66] Hist. Gen., Lugd., l. c.
[67] Herrera. Agric. Gen., ed. 1809, II., 114, quoted from D. C. Geog. Bot., 906.
[68] F. Colombo. Hak. Col., II., 533.
[69] Narrative of Pasceral de Andagoya, Hak. Soc. Ed., 29.
[70] Pinkerton's Voy., XII., 652; Hakl. Voy., III., 276.

on the St. Lawrence. In New Mexico, *melons* are named by Gomara[71] in 1540, and also 1542.[72] In 1565, *melons* were abounding in Hayti.[73] In 1582 de Espijo[74] speaks of *melons* and pumpkins as grown by the Indians of New Mexico; in 1584 as found in Virginia[75] by Captains Amidos and Barlow; and again as *muskemelons* in 1609.[76] In 1609 also they were seen on the Hudson River,[77] and are described as abundant in New England by Master Graves[78] in 1629, as also by Woods.[79]

In 1806 McMahon names thirteen kinds under American culture. At the present time at least a hundred different names of varieties can be collected.

The *melon* or *muskmelon* is called in France and Spain, *melon;* in Germany, *melone;* in Flanders and Holland, *moloen;* in Italy, *popone, melone;* in Portugal, *melas;*[80] in Greece, *peponia;* in Russia, *dina;*[81] in Norway, *melon;*[82] in Arabic, *beteekh, kirboozeh,*[83] *domeyri, dremmaijre;*[81] in Bengali, *kurbooja,*[83] *khurbuz,*[84] *phuti;* in Burmah, *tha-khwahmwe:*[84] in Comanche Indian, *pehena;*[86] in Ceylon, *rata-komadu;* in Hindustani, *karbooja;*[83] in Japan, *tenkwa, kara uri;*[87] in Malay, *labofrangee;*[83] in Persia, *kharbuza;*[85] in Sindh, *gidhro;*[83] in Tagalo, *tabogo;*[85] in Tamil, *molam;*[84] in Tartar and Turkish, *kaun.*[81]

MINT. *Mentha viridis* L.

This garden herb was well known to the ancients, and is mentioned in all early mediæval lists of plants. Amatus Lusitanus[88] in 1554 says it is always in gardens, and later botanists confirm this statement for Europe. It was in American gardens

[71] Wipple & Turner. Pac. R. R. Repts., III., III.
[72] Cabeca de Vaca, Relation. Smith's ed., note, p. 165.
[73] Benzoni. Hist. of the New World, Lond., 1857.
[74] Hakl. Voy., III.
[75] Pinkerton's Voy., XIII.
[76] A True Decl. of Va., 1610, 13.
[77] Delafield. N. Y. Agr. Soc. Trans., 1850, 359.
[78] Mass. Hist. Soc. Coll., 1st ser., I., 124.
[79] Woods. New Eng. Prosp., 1st ed., II.
[80] Vilmorin. Les Pl. Pot., 1883, 332.
[81] Decandolle. Geog. Bot., 906, 908.
[82] Schubeler. Culturpflanz, 108.
[83] Birdwood. Veg. Prod. of Bomb., 156, 301.
[84] Drury. Useful Pl. of Ind., 172.
[85] Pickering. Ch. Hist., 229.
[86] Marcy. Red River, 275.
[87] Kaempfer. Amoen., 811; Thunb. Jap., 323.
[88] Amatus Lusitanus. In Diosc., 1554, 319.

in 1806,[89] and probably far earlier, for it was collected by Clayton in Virginia about 1739[90] as a naturalized plant.

Mint, green mint, or spearmint is called in France *menthe vert;*[91] in Spain, *hierva buena, ortelana;* in Italy, *menta;* in Germany, *muntz;* in Arabic, *nahanaha;*[92] in the Mauritius, *menthe;*[93] in India, *podeena;*[94] in the Deccan, *pahari-poodenah.*[95]

MUGWORT. *Artemisia vulgaris* L.

This plant, of insignificant use, is yet included among the plants of the garden by European writers. The leaves are strong, bitter, and aromatic, and are sometimes used for seasoning.[96] It was formerly employed to a great extent for flavoring beer, before the introduction of the hop,[97] and the leaves are said to have been used for food in China in the fourteenth century.[98] It is as yet scarcely in the vegetable garden, and it is unnecessary to inquire when the first entry was effected.

The *mugwort* is called in France, *armoise, couronne de St. Jean, herbe a cent gonts;* in Germany, *beifuss;* in Holland, *bijvoet;* in Italy, *santolina;* in Arabic, *artemasaya, utmeesa;* in Hindustani, *nagdowna;* in Persia, *birunjasif;* in Telugu,[99] *davanamu;* in Japan, *gai* or *jamogi.*[100]

MUSTARD. *Sinapis* sp.

Mustard was well known to the ancients, but the use seems to have been more medicinal than dietetic, yet Apicius,[101] about 230 A. D., makes frequent uses of it in his receipts on cookery, and in an edict of Diocletian, A. D. 301, it is mentioned along with alimentary substances. In Europe, during the middle ages, mustard was used with the salted meats which formed such a

[89] McMahon. Am. Gard. Cal., 1806.
[90] Gronovius. Virg., 1762, 89.
[91] Vilmorin. Les Pl. Pot., 1883, 353.
[92] Camerarius. Epit., 1586, 477.
[93] Bojer. Hort. Maur., 1837, 247.
[94] Speede. Ind. Handb. of Gard., 1842, 183.
[95] Birdwood. Veg. Prod. of Bomb., 64, 241.
[96] Vilmorin. Les Pl. Pot., 1883, 12.
[97] Johnson. Useful Pl. of Great Brit., 154.
[98] Bretschneider. Bot. Sin., 51.
[99] Birdwood. Veg. Prod. of Bomb., 47.
[100] Kaempfer. Amoen., 1712, 897.
[101] Apicius. De Opsoniis, etc., Anesblodami, 1709.

large portion of the winter diet of our ancestors.[102] It is, however, as a vegetable that we treat of it here.

Sinapis alba L.—White mustard is grown in gardens for the young leaves, which are used in salads, and about London is grown in gardens to a large extent. In 1542 Fuchsius,[103] a German writer, says it is planted everywhere in gardens. In 1597, in England, Gerarde[104] says it is not common, but he has distributed the seed, so that he thinks it is reasonably well known. It is mentioned in American gardens in 1806.[105]

White mustard, or Salad mustard, is called in France, *moutarde blanche, moutardin, plante au beurre, seneve blanc;* in Germany, *gelber senf;* in Flanders, *witte mostaard;* in Holland, *gele mosterd* or *mostaard;* in Italy, *senapa bianca;* in Spain, *mostaza blanca;*[106] in Greece, *agriourouva, napi, sinapi;*[107] in China, *kai kie.*[108]

Sinapis nigra L.—The black mustard is described as a garden plant by Albertus Magnus[109] in the thirteenth century, and is mentioned by the botanists of the sixteenth century. It is, however, more grown as a field crop for its seed, from which the mustard of commerce is derived, yet finds place also as a salad plant. Two varieties are described, the *black mustard of Sicily* and the *large-seeded black.*[110] It was in American gardens in 1806 or earlier.

Black mustard, brown mustard, or *red mustard* is called in France, *moutarde noire, navuce rouge, russebau, seneve noir;* in Germany, *brauner senf;* in Flanders, *zwarte mustaard;* in Holland, *bruine mosterd;* in Spain, *mostaza nigra;*[106] in Italy, *senape, senapi.*[107]

Mustard.—Chinese Cabbage-Leaved.—This vegetable, the species not indicated, is described by Vilmorin[106] as under European culture, and he says that in warm countries it forms one of the most highly esteemed green vegetables. In China *Sinapis*

[102] Pharmacographia, 1879, 64, 69.
[103] Fuchsius. De Stirp., 1542, 537.
[104] Gerarde. Herb., 1597, 190.
[105] McMahon. Am. Gard. Cal., 1806.
[106] Vilmorin. Les Pl. Pot., 1883, 355.
[107] Pickering. Ch. Hist., 246.
[108] Bretschneider. On the Study, etc., 17.
[109] Albertus Magnus. De Veg., Jessen ed., 1867, 568.
[110] Vilmorin. The Veg. Gard., 1885, 352.

brassicata L. is said to be cultivated abundantly,[111] and *S. chinensis* L. to occur in Cochin-China in two varieties. *S. pekinensis* Lour. was introduced to France from China in 1837.[112] This plant, says Livingston,[113] is more extensively used by all classes of the Chinese than any other,—perhaps than all the others together. It is carried about the public streets for sale, boiled, in which state its smell is extremely offensive to Europeans. It is recorded as in the United States by Burr[114] in 1863. In Portugal its seeds were sown by Loureiro on his return from Cochin-China in the eighteenth century.[111]

THE SEGREGATIONS OF POLLED RACES IN AMERICA.

BY R. C. AULD.

COMING to America itself it is interesting to investigate the tendency toward the throwing off the horns among the native cattle, as developed by the environment of so decidedly different characters from that the species was formerly accustomed to.

South America.—In a passage quoted from Major Hamilton Smith, allusion was made to the occurrence of polled cattle in Spain; and on the supposition that they may have been transported thence to form the polled breed of Assumption in Paraguay. Darwin seems to have disregarded this view; for his opinion is that they "appeared suddenly from what we call spontaneous variation," this being the only instance in which the origin and formation of a polled race were fully known.[1]

[111] Miller's Dict., 1807.
[112] Bon Jard., 1882, 533.
[113] Livingston. Hort. Trans., V., 54.
[114] Burr. Field and Gard. Veg., 1863, 386.
[1] Letter to Macdonald and Sinclair, authors of "History of Polled Cattle."

Dr. J. Cowles Pritchard (Hist. of Man), while alluding to these South American cattle, "which are brown, red, and black," refers to the observations of Don Felix de Azara (Voyages dans l'Amérique Méridionale), also quoted by Darwin, who states that in 1770 a bull without horns was born, from which a race so characterised was founded;—"En 1770 il naquit un taureau mocho ou sans cornes, dont ca race s'est très multipliée." He notes the influence of a polled bull. The calves by him were "also destitute of horns." This case, stated to be the only instance of the origination of a peculiar breed taking place under man's own observation, and the only instance of such a kind within the knowledge of such an eminent investigator as Darwin, is very interesting.

A year or two ago a gentleman of Buenos Ayres informed me that polled calves occurred among herds on the Pampas.

North America.—Speaking of the early importations of cattle into Maine, Dr. Holmes states ("Agriculture of Maine," p. 80; 1855): "Up to 1719, there were also occasionally found some polled or hornless cattle, which were probably introduced from England, or from some of the British provinces adjoining us."

In an interesting essay entitled "Remarks on the Physiology of Breeding," contained in the "Report of the Commissioner of Agriculture, Washington, 1863," Mr. S. L. Goodale states "that many years ago there were in the Kennebec valley a few polled or hornless cattle. They were not particularly cherished, and gradually diminished in numbers. Mr. Payne Wingate shot the last animal of this breed (a bull calf or a yearling), mistaking it in the dark for a bear. Thirty-five years subsequently all the cattle upon his farm had horns, but at the end of that time one of his cows produced a calf which grew up without horns, and Mr. Wingate said it was in all respects the exact image of the first bull of the breed brought there.

Judge T. C. Jones, of Delaware, Ohio, writes that in his boyhood days, say three-score years ago, "the cattle in the Ohio valley, as in other parts of the United States, were of every variety of form and color,—some with and some without horns. This diversity of characteristics resulted from the fact that emi-

grants from Europe brought with them whatever sort was reared in the various localities in which they lived;—some Dutch, a few French; but the majority from various parts of the United Kingdom."

Mr. William Warfield, writing in 1883, said: "I well remember spending the night, nearly a quarter of a century ago, with my father, Captain Warfield, and Dr. R. J. Breckinridge, at the home of Colonel Henry Clay, of Bourbon county, and seeing driven up for our admiration a whole herd of what he called "short-horn muleys"—rather a paradoxical title, but not an unmeaning one. A splendid lot of plums they were, and their owner and inventor was justly proud of them. He had made up his mind, like many of our Western men, that hornless cattle were desirable, and he was convinced that short-horns were the most desirable breed in existence, and so he just set to work and made himself a herd of hornless short-horns. I never learned from him the exact details or the tediousness of the process he pursued further than that he started with a few 'muley' cows—common beasts—and short-horn bulls. But the result spoke for itself. We may ask in vain, What has become of them? In England we should have had them preserved and admired, and made into a wide spread and esteemed polled breed, which in course of time would have had its herd-book, and its great auction, and its enthusiastic supporters. In America, like the achievements of so many of our men of talent, they are left to fade away into nothing. No man takes interest enough in them to keep them up. They are worth just so much per pound, and when a cry arises from our western plains for a hornless race, they are brought, at expense of time and money, from Angus and Aberdeen." In regard to this lament, as far as the shorthorns are concerned, it would seem, according to a recent article by William Housman, of England, that the reverse of the above is the case, and the latter country seems destined to do the lamenting; for, as will be immediately seen, it has been left to this country to preserve and establish a variety of polled shorthorns, and to rescue this variety from the "swamping effects of intercrossing."

In the "History of the Red Polled Cattle," Vol. II., 1883, of the Red Polled Herd-Book, published at Norwich, England, Mr. H. F. Ewen, the Secretary, says:

"'Muley' cattle have been in Virginia for a great many years, and their descendants have also been uniformly polled. The use of a Red Polled bull has specially brought the young stock to the desirable uniformity of color. It would be of value to the students of the history of cattle were search to be made respecting the introduction of polled stock into America. It is recorded that many of the earlier settlers were natives of Norfolk and Suffolk villages. May they not have taken over the polled cattle which in that day were so numerous in Suffolk and on the Norfolk borders?" This passage has been commented on, and we leave it here till we deal with the philology of the subject.

Mr. A. B. Allen, a well-known authority in America, writing me on the subject of "Muleys," says: "I have read your articles with much interest, and regret to say I can give you no further information on our native muleys otherwise than that I know them only as bred from imported European stock, which has been introduced into America from time to time, ever since the settlement of the country, and is sparsely scattered over it. Polled cows have been crossed by all sorts of bulls in this country, but no distinct race has been bred from their crosses. They are mixed up helter-skelter, like all the rest of the native cattle. In native cattle I do not include Shorthorns, Devons, etc.; although bred for generations in our country, we keep them distinct, and class each breed by itself." But there have been a few breeders scattered about who have made attempts, and successful ones, at establishing "native" races of polled cattle from the general conglomerate formed previous to the "distinct" breeding period.

Gen. Ross, of Iowa City, Iowa, also writes: "I have really no opinion as to the origin of the native polled or muley cattle of the United States. From my early boyhood — over fifty years ago — in Illinois, I remember to have seen occasionally a polled cow or steer. They were all colors. The cow that was the ancestor of my home-bred polls was white. Two crosses were made with the Shorthorn, and one with the Devon, by

which I procured my first red polled bull, Brigham Young. He was one-half Devon, three-eighths short-horn, and one-eighth unknown blood. One of the best cows of my herd is exactly of the same blood — a beautiful red color, and nicely polled."

Mr. E. W. Perry, of Chicago, informs us that about 1848 Henry Carver took from Ohio to Muscoda, Wis., a number of white polled cattle. He used two yoke of white polled oxen. For a few years his cattle were bred pure, probably from bulls out of his own herd; but wherever the cows were crossed with scrub bulls — there were no improved cattle there at that time — the calves came white and polled in almost every instance. All had black muzzles and ears; and down about the feet and on the fore-legs a few black or brown spots, about the size of a dime to a quarter. About 1853, A. Palmer, of Boscobel, bought one heifer, and from her got a white heifer, polled. Since then he has always had some of them on his place. These white cattle were favorites, because they were very docile, large and rich milkers, and fair beeves, being of good size and reasonably hardy.

I have made extensive inquiries into this matter in America, and I find that in all directions and in all classes of the "natural" stock — from the scrubs of the Eastern States to the long-horned Texan, almost extinct now in its pure-bred state of ultra-Uri type — muleys, or mulleys, or mooleys, are common. Usually they seemed to be regarded as something bastard; and an animal fit only for ridicule and ill-treatment. Any amount of ill-usage they could endure, it was thought. They were of all colors. In a few cases, however, they were prized for thrift, and as pet milchers; and formed a foundation for those who thought of naturalizing a local polled sort.

The following, by Mr. Wm. W. Towne, gives a very graphic idea of the former status of polled cattle in America, and shows how they were given over to neglect — a curious contrast to the high position attained by the muley to-day:

"Ten years ago hornless cattle in America, as a fixed breed, were almost unknown. The few natives seen were regarded as freaks of nature, their peculiar features not justified by their

ancestry, and, excepting here and there a man strangely awakened to the comfort and safety of his cattle, no one thought of collecting a herd of them. The term 'mulley' was an epithet to imply low rank in cow circles. In the village where I was born, the mention of Jake Thompson's or Joe Brown's old mulley cow brought to mind a neighbor who was generally out of work, and always out at the elbows, who hunted a little in winter, fished some in spring time, worked a few days at double wages for the farmers in harvest, and completed his efforts at earning a living by digging snake-root and ginseng from the forests around, which he exchanged at the general store for whiskey and tobacco, necessaries in the households of Messrs. Thompson and Brown. This for a routine picture of the owner of the cow; and, as I recall her outline, I remember a cat-hammed beast, with a big udder, ewe neck, small shoulders, poor in flesh and shag in coat, who lived by stealth as her owner lived in idleness. Among the bovine aristocrats of the thriving farmers near around, the mulley cow had no welcome, and if she ever came by unlooked-for birth or unsought purchase, she was either sold to Thompson and Brown, aforesaid, or sent to the butcher. And yet for the children of Thompson and Brown she was both bread and meat, as all the grown-up T.'s and B.'s will affirm.

"Those patient old polls! It was a wonder with me that they continued to be born at all after so many years of neglect, if not outright extermination. Looking around for a reason for their continued existence, it was found in their intrinsic worth. So soon as there was talk among the neighbors of the advantages of hornless cattle as herders, feeders and shippers, it was a gratification to learn that every man spoken to had kind words for some old, uncrowned bossy of memory; the villagers, Thompson and Brown, found them large producers of milk, great foragers, and hence the best poor man's cow in all the land. Lack of food and housing care did not give them rounded forms; generations of cruel neglect robbed them of ancestral beauty, and they were only permitted to survive for the fittest of all reasons — they were useful. Nearly every farmer, it was found, had fond recollections and kind words for some old smooth-pated cow, recalling

her quiet ways, and more than average milking qualities. Docility and milk — these are great parts in anybody's cow. If to these we add form and size, the long sought for 'general purpose' cow is found."

"*The Guinea Cow.*"—This is the name of a race but little known beyond Florida and the southern tier of counties in Georgia. The race is now well established, their most prominent characteristics being their adaptability to the region to which they belong. Early in the present century Col. Stapler, who lived near the Florida line, in Lowndes county, Ga., owned several of them, and so far as known all the present herd are descendants of the Stapler stock. *The Breeders' Gazette* published some account of the Colonel's efforts to establish the race, from which we quote. The supposition is that they may be traced to some Brittany cattle imported by some settlers from that country:

"The native pasturage of the pine barrens was neither abundant nor luxurious, indicating the necessity for an animal of small bulk, hardy, and a wide ranger. He succeeded in getting an admirable little animal, that asks for little other food than the scant supply of grass she can gather upon the range, and will keep fat upon a diet that to the larger breeds would be starvation rations. As to size, some fellow says: 'She is a yard high, a yard and a half long, and about a yard wide.' One brought to Enterprise, Volusia Co., Fla., is described by the local paper as follows: 'She is broad on the back, slim neck, small and delicate legs and feet, well filled up in fore and hind quarters, long for her height, which is just thirty-nine inches, and an eye in which meekness and content with gentleness shines. She keeps fat where a common Florida cow would starve, and gives about two gallons of milk, of a high grade, twice a day. This little cow might butcher about 400 lbs. net, and is undoubtedly the most contented and gentle animal in Florida.' Another says: 'Their body is scarcely a foot from the ground, and the udder is enormous. They are hardy and gentle, active browsers, and eat about half what is needed for an ordinary cow.' Yet another says: 'They are usually of a deep red color, always fat and gentle, with crumpled horns and deep escutcheon. They require less food and give

more milk than the ordinary cow, and are much hardier and more intelligent.'

"They differ considerably in both size and color; while some are polled others are not. This diversity is doubtless owing to the different degrees of purity of blood. For years it was known as the 'Stapler cow,' and attracted but little attention. But after sales from this herd began to be made the people of the surrounding counties came to appreciate their excellence, and of course they must have a name, and 'Guinea' was the result. The demand for the 'little cow' was such that it was seen to be worth while to breed them for sale. When found for sale the price ranges from $40 to $100 for females; males much lower."

The Jamestowns is the local name used to designate a family of cattle that sprang from a pure Suffolk heifer that came to this country in the United States relief ship "Jamestown" (Captain R. B. Forbes), in the year 1847, on its return from a trip to Ireland loaded with a cargo of provisions for her starving inhabitants. This heifer was given to Captain Forbes by the Lord Lieutenant of Ireland as a token of acknowledgment on the part of his people. The heifer proved a deep milker, giving at her best twenty-six quarts per day, beer measure, of the richest milk. She was bred for several years to Jersey and other horned bulls, nearly all her progeny being without horns, though all her calves but one, so far as I can learn, were bulls, which, according to my experience, are much more likely to show the horns than are heifers from such cross-breeding. In 1854 this remarkable cow dropped a bull-calf sired by Thomas Motley's Jersey bull Beverly. This bull was out of Flora by a first-prize winner at the Royal Agricultural Show in Jersey. Flora was one of the best cows imported by Mr. Motley, having made sixteen pounds of butter per week. The calf was named Jamestown from the ship that brought over his mother, and was secured by the late Dr. Eben Wight and brought to Dedham, Mass., where he was kept many years, leaving a numerous progeny, and so highly was the blood prized by the people in the vicinity that a vote was at one time passed at a meeting of the Norfolk county Agricultural Society,

permitting Jamestown to compete for the Society's prizes on an equal footing with other distinct breeds.

The American Agriculturist also recently described a race of white polled cattle that has been successfully raised in New York state, and gave some excellent figures of them as well as details concerning them. In concluding its interesting account it says: "We regard these polled cattle as distinctly American as any cattle we have. They have, of course, a European origin, but what it is remains in obscurity. They are to-day as truly American as are the Chester White pigs, Vermont merino sheep, Plymouth Rock fowls, or Morgan horses." Why not start a Register for these American polled cattle?

At the Ohio Centennial Exhibition, held at Columbus last fall, Messrs. Clawson and Shafer exhibited some very fine specimens of native polled Durham's, *i.e.*, cattle raised from native muleys of Durham stock.

Pure-bred Polled Shorthorns.—But the most interesting modern instance supplied by America is that of providing specimens of polled individuals among pure bred shorthorns. A small herd of these was established near Minneapolis, Minnesota, the joint property of Mr. H. W. McNair and the estate of Hon. W. W. McNair. These cattle are all descended, either through dam or sire, from Oakwood Gwynne 4th (an imported Medora by Horatio) by Marquis of Geneva 10451. Nellie Gwynne and Mollie Gwynne (twins of October, 1881), from this cow and by 7th Duke of Hillhurst 34221; her bull calf King of Kine (August 15, 1883), by Bright Eyes Duke 31894; also Nellie Gwynne 2d, out of Nellie Gwynne and by Favorite 48182; Mollie Gwynne 2d, out of Mollie Gwynne and by King of Kine—all were entirely devoid of horns from birth, and King of Kine, at the head of this herd, has in one instance only got a calf with horns, and in that case the horns were very small. There is also in the herd Hazel Hill Pride (calved October 6, 1886), by King of Kine, out of Music Gwynne 6th [an imported Music by (9918)], and Lord Elmor (calved July 9, 1887) by King of Kine, out of Eugenie 4th (an imported Britannia), both "doddies."

These cattle will all appear in Vol. XXXIII. of the herd book.

This little herd was purchased by W. S. Miller, of Elmore, Ohio, and exhibited by him at the Ohio Centennial Exposition at Columbus last fall.

Mr. Miller informs me that the following breeders have had pure-bred mooley shorthorns in their herds: J. M. Jackson, Coitsville, O.; R. Baker, Elyera, O.; and Jacob Powell, Independence, Mo. But it is only now since the advantage of the want of horns on cattle has become apparent—and when it has been demonstrated that the hornless cattle can be as masterful and of as good quality as the horned—that the polled tendency has been watched for by shorthorn breeders, and the character severed from "the swamping effects of free intercrossing with the parent form"—a principle made prominent recently by Prof. G. J. Romanes, F.R.S.

A few years ago a hornless Durham bull was brought to Richmond, N. Y. Mr. Pitts, a breeder of pure shorthorn cattle, kept the bull for use in his herd, and his get proved to be hornless, and the hornless stock being sold in neighboring towns founded this variety, which was here shown and received premiums.[2]

William Warfield, commenting on "Inbreeding and Crossing," uses the following illustration: The former of a new breed is ordinarily in the position of having nothing but one or two representatives of the direction in which he wishes to improve. What can he do but in-breed? Say, for instance, that a hornless calf is accidently produced, and we wish to frame a breed of hornless calves, nothing is left to us but to breed this calf to his own daughters and granddaughters—to breed his offspring together, and so on, not because inbreeding as inbreeding 'fixes a type,' or 'improves,' but because these are the only hornless cattle we have. If we had other hornless cattle inbreeding would be a folly. It consequently happens that in the formation of any breed inbreeding is a necessity."

The above selections of cases are necessary to the complete consideration of the subject of "The Mooley Cow," and afford some excellent illustrations of the principles and theory of breeding and selection.

[2] *National Live Stock Journal*, Nov. 1881, p. 485.

THE EFFECT OF RAIN ON EARTH-WORMS.[1]

DURING the rain in Washington, D. C., on the 20th of March, my attention was attracted to the earth-worms so abundant on the paths, the sidewalks and the streets of the city. They seemed to be everywhere. Some were large, some small; some active, some sluggish; some alive, many dead. I had noticed their presence before during January and February in the Capitol grounds, especially on the pavements. I supposed then they had simply come out from under some rubbish lying along the sides of the walks, and that they would straggle back again. I have since come to a different conclusion,—a conclusion which is, in effect, that few indeed of those which come out are ever able to, or at least seldom really do, straggle back.

During the time referred to I determined to see, if possible, the extent of the mortality among the earth-worms. So I took the opportunity of counting, as I walked slowly along, the number upon the ground, alive or dead. This I did in several places and under different circumstances.

The first place examined was a gravel walk in the Smithsonian grounds, while the rain was still falling. In a distance roughly estimated at 425 feet, I noticed 380 worms. Probably three-fourths of these were dead, lying drowned in pools of water, or else crushed by the feet of passers-by. On another path in the Smithsonian grounds were some very large examples, one of which was at least nine inches in length and as large round as an ordinary lead pencil. I have since seen specimens even larger than this.

A second place examined was on the asphalt sidewalk of Massachusetts avenue, between Fourteenth and Fifteenth, a distance of about 600 feet, and after the rain had ceased. In this distance I counted 180 worms, the dead ones averaging nine out of every ten. On one side of this stretch is a stone wall, generally with a considerable amount of dirt at its base, and on the

[1] Read before the Biological Society of Washington, April 20, 1889.

other side is a narrow strip of soil. The worms were counted as I walked slowly along, and it is most probable that all were not observed.

A third place was in Franklin Park, between Thirteenth and Fourteenth and K and L streets. Crossing this diagonally about half way, and noting the worms, not on the asphalt walk but on the little strips of gravel alongside, seldom more than twelve or eighteen inches wide, I counted 325 worms. Very few of these were alive. It was sprinkling slightly at the time and the ground was wet. Many lay in puddles of water where they had been drowned. During a rain of the following week I noticed the worms in the same place again, this time not so numerous. But the strip of gravel was marked all over by the trails left by the crawling creatures.

A fourth locality, and one seemingly very favorable to the existence or appearance of the worms, was on Fifteenth street, just north of Rhode Island avenue. The sidewalk was brick, and at one side was an open lot used as a tennis court. In a distance estimated at 200 feet I counted no less than 340 worms. They lay in the cracks between the bricks, on the bricks themselves, and in little pools of water. I doubt if there were a dozen alive out of the 340.

These four places were by no means the only ones where the worms were seen. On the roads and paths in the neighborhood of the Smithsonian and National Museum, on Fourteenth street, on Thirteenth street, on Massachusetts avenue, where there was a brick pavement, they were equally numerous. As before stated I had previously seen them in the Capitol grounds and other places in the Northeast.

There are two points of interest connected with this subject. One is the extraordinary abundance of the worms, and the other is their excessive mortality. We have, of course, no way of knowing positively the number of these creatures to each square yard or square foot of surface. Darwin, quoting Henson, says (Formation of Mould, pp. 158, 159), that there are in England about 53,767 to an acre: that he has seen 64 burrows in 14½ square feet, or 9 in 2 square feet. Further, that in a cake of

dry earth as large as his two hands, there were seven burrows as large as goose quills (p. 160). If the numbers observed here above the surface are any good index to those below, their total number must be simply enormous.

The mortality among the worms, as shown by the number of dead ones, is immense. Taking the number as given above for a single acre—53,767—we find there are five to every four square feet, or 1¼ for every square foot of surface. Calculating the area observed in Franklin Square and the number there seen, we find one worm for every one and a half square feet. In the same way the number seen on Fifteenth street was one to every five and a half square feet, and in the Smithsonian grounds one in every nine square feet of surface. It should be remembered that the larger part of these were dead, and if, as in the case of Franklin park, one for every one and a half square feet out of a possible five in every four square feet die, it is easily seen that the mortality is enormous. If this proportion holds out in any way at all over the two hundred and seventy and odd miles of streets in Washington, what an epidemic among the worms there must have been during the three-days rain referred to.

Again, what is the cause of the mortality? We cannot say they are crushed by the feet of pedestrians, because many of them show no signs of injury. It would seem as if, attracted to the surface by the moisture, they crawl out upon the hard asphalt or gravel, and then finding it impossible to return to Mother Earth, die on account of exposure, or are drowned in the deluge of water, many meeting death in the last form.

A NATURALIST'S RAMBLES IN CEYLON.

BY H. HENSOLDT.[1]

ABOUT fourteen years ago—it was in October, 1875—when I was a student at Giessen, a small but well-known university town in Germany, a friend, and for awhile fellow-student, Dr. Ferdinand Goldschmied, was preparing for a voyage to the distant island of Ceylon. Dr. Goldschmied was a young man of unusual attainments, an enthusiast, a lover of science for its own sake,—not one of those who look upon science as a sort of trade, which they follow for the sake of what it is likely to bring them in the shape of money or fame. He took an interest in every department of science, but his favorite subjects were ethnology, oriental languages, and the ancient civilization of the East.

A year or two previous to this German orientalists had been greatly excited over the publication (by a Leipzig professor) of a little work on ruined cities in southern India, Ceylon, and several of the islands of the Malay archipelago, such as Java, in which it was attempted to prove that long before the Aryan invasion—at a time so remote that neither history nor tradition has preserved the slightest trace of it—these countries were densely inhabited by a race of people possessed of a high degree of civilization, as evinced by the splendor of their cities, still imposing in their ruins, by their enterprise and skill in constructing reservoirs, tanks, canals, highways, etc., rivaling in this respect the most celebrated achievements of modern engineering, but a race which in language, customs, architecture, and so forth, was totally different from the present inhabitants of these countries.

Dr. Goldschmied was profoundly impressed with this work. Here was an entirely new field for research, a field practically untrodden, and promising glorious revelations; here perhaps lay buried some of the most important secrets of the past (he was one of the believers in the vast antiquity of the human race), but a field accessible only to one who could personally go and

[1] School of Mines, Columbia College, New York.

explore it. And so, although his means were slender, and his constitution none of the best, he resolved to set out on what may be truly termed a voyage of discovery, prepared for years of toil and travel in the tropics of the East, and the island of Ceylon was the country he intended to explore in the first instance.

When Dr. Goldschmied first asked me to accompany him, I treated the matter as a joke, for nothing, I thought, could be more foolish for one like me, still engaged in study and with a particular career sketched out for him, than to embark in such an enterprise. But I began to reflect over the proposal, and the more I reflected the more attractive it became, the more fascinating, until it grew perfectly irresistible, and to the surprise of many friends, and against the advice of near relatives, who predicted dire calamities, I determined to go with the young explorer.

More than thirteen years have elapsed since then, and I cannot say that I have once looked with regret upon that resolution. It was a mistake in some respects; it drew me away from what looked like a promising career at home, and flung me upon the very high seas of life; it brought in its train many troubles and disappointments which I would not have encountered had I remained in the fatherland, but those two years of Eastern travel taught me a number of invaluable lessons. It opened my eyes to things which I would never have understood had I stayed at home,—things of surpassing interest and beauty; it afforded me an insight into the mysteries of an almost unknown world, an insight into some departments of natural history which no amount of book-study could have given me, even if I had mastered whole libraries of science; it enlarged my horizon, and gave me a totally different idea of this queer world in which we live: indeed I may say that I shall never regret that voyage to Ceylon.

Now I do not here propose to give the details of this voyage in a sort of diary-fashion. I presume that the reader does not care over-much for an account of mere incidents of travel; what I desire is to tell him something about Ceylon, about my impressions of that island, of what I saw and observed there during a two years' residence, and I shall drop the style of personal narrative as much as possible, and only revert to it when absolutely

necessary. But a few words on the voyage out may not be amiss here. We left Germany on November 12th, 1875, starting from Frankfort, and traveling through Southern Germany, a part of Switzerland, France and Italy to Genoa, on the Mediterranean. This was *via* Geneva and the great Mont Cenis tunnel. Owing to an unfortunate delay of nearly a day at Turin we managed to miss a certain steamer of the Rubattino line, with which we had intended to sail, and as we would have had to wait more than fourteen days for another, we left Genoa, within two hours after our arrival, for Marseilles, where we secured berths on board the *Anadyr*, one of the French mail-steamers, of the Messageries Maritimes, which go to China, but touch at Ceylon and Singapore. During the passage through the Mediterranean we had the opportunity of seeing no less than three volcanoes, viz., Mt. Vesuvius, at Naples (where the steamer called for additional mail and passengers), Mt. Etna, on Sicily, and Stromboli, that singular little volcano—one of the Lipari islands—which rises abruptly from the waters, and which we passed within a few hundred yards distance. The Suez canal struck me as singularly narrow; so narrow indeed it is that two moderate-sized steamers cannot safely pass one another, and that was the reason why it took our steamer nearly two days to go through (the canal is only some eighty miles long.) Whenever a steamer was sighted or signaled coming the other way, one of the vessels had to turn into one of the basins which are cut into the sides of the canal, at intervals of about two miles, and this takes a great deal of time, so that a ship may take three days and longer in going through that canal. The voyage from Suez to Aden, through the Red Sea, which took about six days, I still hold in lively remembrance. The heat was something terrible, and there was no escape from it; a young Frenchman died on board with sunstroke. Dr. Goldschmied and I were the only Germans on board, the majority of the passengers being Frenchmen, bound for Saigon on the coast of Annam, and the rest Spaniards, going to Manilla.

We landed in Ceylon on December 9th, exactly three weeks after our departure from Marseilles. So much of the voyage. Dr. Goldschmied's mission, I am sorry to relate,—the great task

which he had set himself of unraveling the mysteries of a forgotten past,—was not accomplished; he died of jungle fever two months after our arrival at Anuradhapura, in the wilds of northern Ceylon. Of this Anuradhapura I shall have occasion to say more anon. It is the most remarkable labyrinth of ruins yet discovered on the island, and is now believed to have been the capital in that very remote past. The ruins, now completely surrounded and partly covered by the jungle, extend over an area of many square miles, and were then as now practically unexplored, though a number of coffee-planters, English officers, and other Europeans residing on the island had visited them,—more, I dare say, to gratify curiosity, and for the sake of the sport that could be had in the hunting of elk and elephants on the road, than to carry on systematic explorations. This region is now exceedingly unhealthy, like most of the low-lying districts of Ceylon, and so it happened that shortly after our arrival Dr. Goldschmied, and two young Englishmen who had joined us at Colombo "to see the fun," as they expressed it, were attacked with dysentery and jungle fever, the two most dreaded diseases to Europeans on the island. The Tamil coolies we had with us and, strange to say, my humble self, remained in good health, but poor Goldschmied died after about ten days of dreadful suffering. Had he lived, I am firmly persuaded that he would have become one of the most famous of men; he had all the elements of a true scientist, and though young was a profound Sanscrit scholar. He would have developed into another Max Müller; in fact, would have outrivaled that great orientalist and philosopher.

I did not continue Goldschmied's explorations. I had not the necessary preliminary knowledge to enable me to attempt such a task; my studies and tastes lay in other directions. I was interested in geology, mineralogy, in zoölogy, in botany,—in short, in natural history, and I remained for two years in Ceylon, gathering such information as I could, making collections, and observing things generally to the best of my ability. I traveled from the extreme north to the extreme south of the island, and from east to west, in all sorts of directions; spent months in unhealthy, swampy regions on the coast and in the interior;

months in the lovely hills and valleys of the central highlands; in towns, villages, on coffee plantations; in remote hamlets among the natives of the backwoods on the gem-rivers: indeed, there is hardly a spot of interest on that island which I did not visit.

And now I will endeavor to give an account—a very condensed account—of some of the things which I saw and observed there. A few preliminary remarks on the island in a general sense may be here of value.

The Island of Ceylon was known already to the ancients, and we find it frequently alluded to, under the name of Taprobane, by Greek and Roman writers. To the Arabs it was known as Lanka and Serendib, and under this latter name it is mentioned in the "Arabian Nights" as the scene of some of Sindbad the Sailor's remarkable adventures. Some modern investigators have asserted that Ceylon is identical with the land of Ophir, whence Solomon obtained his gold, precious stones, and ivory; but as this very land of Ophir has already been searched for in various parts of Africa, on the Island of Madagascar, and even Sumatra, I only mention this as a curiosity. According to a tradition still current in the East Ceylon was the original seat of paradise. The "Vajasanga-Sanhita," one of the sacred books of the Brahmins,—a collection of Sanscrit myths, the age of which Max Müller, the greatest Sanscrit scholar and orientalist of the present, estimates at something like 4,500 years,—contains a legend quite similar to the Bible tradition of paradise, a legend which in my opinion has served as original to the latter. Even the names are almost identical: a first pair of human beings, Adiah (Adam) and Evana (Eve) were created by Brahma and placed in the Paradise, which was Lanka, the Island of Ceylon. They were of gigantic size, says the Sanscrit legend. For some offense they were driven out of paradise; Adiah, on his flight to the mainland of Asia, placed his left foot on a mountain-top in Ceylon, while he planted the right, with a single step, near Markuna in Siam, a distance of about 1,500 miles.

Now in the southwestern part of the island, about fifty miles from the coast, and isolated from the central range, the so-called Highlands of Ceylon, there rises a singular mountain, a very

symmetrical cone — yet not of volcanic origin — about 7,000 feet high, which has been known to the Singhalese (the natives of Ceylon) from time immemorial as "Adiah-Ruah," or Adam's mountain, and which is recorded on every map of Ceylon as Adam's Peak. On the summit of this mountain is a flat piece of rock, garnetiferous gneiss, on which is to be seen the distinct impression of a gigantic foot. This is said to be Adam's foot-print, and the Buddhists of Ceylon, as well as the Brahmins of India, the Tamils, and even the Mahommedans there are vying in the homage which they pay to this sacred relic. A low wall has been built around the "foot-print," and a purple awning, supported by wooden pillars, keeps off the rain, while a number of Buddhist priests are engaged in pious ceremonies, and processions of pilgrims from all parts of Ceylon constantly arrive and depart. I made a point of visiting that celebrated mountain top, and, of course, recognized at a glance that Adam's foot-print was a fraud, and a very big one. It was artificially cut or chiseled into the rock, and, moreover, by a very unskilled person, who had not even omitted to provide *nails* for the toes, notwithstanding the fact that a mere foot-print could not possibly show anything of the kind. Besides, the length of the imprint was in no proportion to that of the enormous stride, for although the foot-print was about 65 inches long, yet for such a stride it ought to have had a length of at least 300 miles. But faith, which as we know is capable of moving mountains, apparently causes the pilgrims to find the looks and dimensions of Adam's foot-print very natural and reasonable. I, for my part, took great care not to appear by looks or questions as if doubting the genuineness of the relic, and even considered it wise to leave a small present for the temple.

The climate of Ceylon is, of course, essentially tropical. From the coast to a distance of about 30 miles into the interior the island is flat and covered with forest and jungle — the latter a dense and thorny mass of vegetation, almost impenetrable to man, and affording shelter to innumerable wild animals, snakes, birds and insects. The tropical forest, on the other hand, is often quite free from underwood. The entire coast is surrounded by a

seam of cocoa-nut palms, which appear to thrive best in the sandy coastal belt, but they are also abundant in the interior, and I have found them even high in the mountains.

The Portuguese were the first Europeans who settled on the island, and for several centuries only the flat coastal region was known to them, as no white man dared penetrate to the mountain country of the interior, which was inhabited by a bold and warlike race, with an ancient and highly-developed civilization. The natives of the coast were evidently only degenerate or effeminate descendants of this mountain race, and very little reliable information did the Portuguese obtain as to the state of things in the interior. Only now and then the natives would tell them of the splendor of the capital, Kandy, situated high in the mountains, the very existence of which was long regarded as a fable. In Kandy an ancient dynasty of kings was said to rule over the noble race of the Singhalese, but woe to the stranger who dared approach its walls. No Portuguese in those days saw the interior of Ceylon, and even the Dutch, who subsequently held the island for a hundred years, never succeeded in penetrating to Kandy. It was only about 80 years ago that the English, who took the island from the Dutch during the Napoleonic war, at the beginning of this century, managed to capture that remarkable town, and thus solve the riddle of centuries.

The present population of Ceylon is about two millions, but the island would be capable of supporting more than ten times that number of people. At least four-fifths of this populace inhabits the coastal region, but only as far as the cocoa-nut trees go, viz., from three to six miles into the interior. Thus the stranger, landing for the first time in Ceylon, and seeing the busy life along the coast, the innumerable huts of the natives in the shade of the giant palms, villages miles long, extending almost uninterruptedly along the entire southwestern coast, from Point de Galle to Colombo — a distance of 75 miles — is apt to consider Ceylon one of the most densely inhabited countries in the world. But if he travels in a straight line to the interior, the scene changes with surprising suddenness, and after proceeding

a few miles he either finds himself in the dense jungle or the solitude of the tropical forest.

More than eighty per cent. of the population of Ceylon consist of the Singhalese, a very remarkable and interesting race, which has resided on that island for at least 3000 years, but probably much longer. The Singhalese differ in many respects from the inhabitants of the continent of India, especially from the Hindoos, with whom they have very little in common. While the average Hindoo is small, delicate, and by no means distinguished for courage, the Singhalese is tall, muscular, extremely well-proportioned, and, moreover, bold and intrepid. Only in the fine antique cast of the features do these two races resemble each other and betray a common origin. It is hardly necessary to remind the reader that the inhabitants of India are not negroes, although the English merchants and officials very brutally and indelicately call them niggers, but a nobly-formed and highly developed race with entirely Caucasian features, so that, except for the difference in color and dress, it would be impossible to distinguish them from Europeans. The Singhalese, as well as the Hindoos, have, on an average, beautiful and expressive faces, well-proportioned bodies, and surprisingly small hands and feet; it is rare to find a downright ugly specimen among them. They are Aryans, a branch of that great Indo-Germanic race from which, as modern ethnology and comparative philology have clearly shown, most of the European races are derived. Sanscrit, that wonderful language of the ancient Hindoos, which has been a dead language for more than 3000 years, holds the key to many a puzzling mystery. In that language—embalmed, as it were, like mummies in an Egyptian tomb, and shrouded in mystery—lay the histories of the origin of numberless races, including those from which we have sprung, till modern philologists began to pierce the gloom, and a Max Müller arose and threw the electric beam of his genius into the ancient manuscripts of the Brahmins, into the Rig-Veda and Ramayana.

The Singhalese have been Buddhists for the last two thousand years, for the teachings of the great Hindoo philosopher were generally accepted by the people already about 500 years before

our era, and the island is even now regarded as the headquarters of Buddhism. Indeed, Ceylon may be called the Palestine of the Buddhists; it is held in the same esteem by the Buddhist world in which Jerusalem was held in Europe at the time of the crusades. To explain this, I must relate a curious tradition. According to the Pali manuscripts, the sacred books of the Buddhists, which are older and at least as reliable as our bible, Buddha came personally to Ceylon about 550 B. C., and preached his new creed, which was received with the greatest enthusiasm, and began to spread with surprising quickness. He had twelve followers or disciples with him. The story of the twelve apostles of Christ is evidently borrowed from the much older Buddha tradition, yet is even here nothing new, but an astronomical allegory, the origin of which must be sought in remotest antiquity. By the twelve followers of Buddha, as well as the twelve disciples of Christ, are meant the twelve signs of the zodiac, which were known already to the ancient Egyptians, Assyrians and Chaldeans. The story of Christ, there cannot be the shadow of a doubt, is an allegory; Christ representing the sun which, rising in the sign of Virgo (the virgin), proceeds higher and higher, till it crosses the highest meridian (whence the origin of the cross), and then, gradually sinking, brings summer to another world (descent into Hades), but ultimately again rises in renewed splendor (resurrection from the dead). These astronomical facts some oriental philosopher tried to interpret to the benighted and unreasoning multitude, and thus once more resorted to the story of a semi-divinity with twelve disciples, which, as we know, is of far more ancient date. Even long after Buddha[2] and Christ, we have again the story of the mythical King Arthur and his twelve knights of the round table, and of Charlemagne with his twelve paladines. Of course we know Charlemagne to be an historical character, but probably so were King Arthur, Christ and Buddha, still that they should all be accompanied by twelve is very significant and points to the same eastern source.

Now Buddha, when he felt his end approaching, commanded his disciples to erect a large funeral-pyre and cremate his body,

[2] Buddha, like Christ, was born of a "virgin," viz., the virgin Maya.

but afterwards they should carefully search the ashes, in which they would find some relic of him, which they were to preserve and treasure as the most sacred thing on earth. Whatever nation had possession of this relic would prosper to the end of time. Buddha's body was faithfully cremated by the twelve, and when they searched the ashes they found nothing but a *tooth*, a single tooth, as all that was left of him. This tooth of Buddha, as Singhalese history shows, has been preserved for more than two thousand years at Kandy, the ancient capitol of the Singhalese Kings, and has been worshipped as something more than sacred. A magnificent temple, the "Maligawa Dalada" (temple of the tooth), was specially erected, which is still one of the wonders of the island. I have often visited this temple during my stay at Kandy, and was always treated with great politeness and kindness by the Buddhist priests. A broad marble stair leads to a kind of raised platform, in front of the temple, whence several passages lead to the interior of the latter. The central one terminates at a curious round tower in which, behind a strong iron grating, is to be seen a miniature Buddhist pagoda, about three feet high and made of gold. In this Buddha's tooth is preserved. Since 1820 no human eye had seen it, for it may only be exposed once every hundred years, except when some great calamity is to be averted,—for instance in times of great drought or pestilence. Then it is brought out and exposed with great pomp and circumstance in front of the temple, and the evil, of course, speedily vanishes. A kind of altar in front of the iron grating is covered day and night with beautiful red Mogra blossoms, which are mostly brought by women as a sacrifice.

Two years previous to my arrival in Ceylon the duke of Edinburgh visited the island, and it was then vainly attempted to induce the chief priest of the temple to show the tooth as a curiosity, but he indignantly refused to expose so sacred an object to the profane gaze of even a duke of Edinburgh. While I was in Kandy, in March, 1876, it so happened that the Prince of Wales came to Ceylon. He had been sent out on a voyage to India, as a matter of policy, by the government, to show himself among the natives and make the English royal house more popu-

lar, as an offset against Russian intrigues. He was received with great pomp at Kandy, and this time the governor of Ceylon, Sir William Gregory, succeeded in getting the head priest to exhibit the tooth of Buddha; thus I also had the rare opportunity of casting a look upon that famous relic.

It was on a Sunday morning, and the news that the tooth of Buddha was to be publicly exposed must have traveled with lightning speed all over Ceylon, for the night before the day in question the large square in front of the temple was crowded with Singhalese, Tamils, and half-castes, who remained there, patiently waiting, all through the night. At about ten o'clock in the forenoon the Prince of Wales appeared with his brilliant suite of Europeans[3] and native chiefs, and ascended the marble stairs in front of the temple. On the platform stood a large ebony table, curiously carved, and covered with a yellow silken cloth. After a few minutes spent in waiting, there issued from the chief portal, slowly and solemnly, a procession of Buddhist priests, with their shaven skulls and long yellow robes. One of them carried a rectangular box, about 15 inches long, and 7 or 8 inches broad, made of gold, and set all around with uncut rubies of considerable size, which he placed upon the table. The chief priest opened it with a small key, and took out of it another box, which was ornamented with the largest, and, perhaps, the finest pearls found in former centuries on the Ceylon coast. In this was another still smaller box, covered with a profusion of uncut gems,—sapphires, rubies, emeralds, etc.,—and in this was an immense sapphire,[4] hollowed out like a cup, in which, upon a golden lotus-leaf, rested the tooth of Buddha. The moment the relic was exposed one of the priests made a sign to the people, and the whole dense crowd sank to the dust in reverence; no Singhalese dared to raise his head to gaze on that sacred object. As for the Prince of Wales and the rest of the assembled Europeans, it was

[3] Among those who accompanied the Prince of Wales on his tour were the Duke of Sutherland, Mr. Russell of the *Times*, and the Russian painter, Verestchagin.

[4] Tradition has it that this marvelous gem was found by a "Rhodia" (Singhalese outcast) in a little mountain creek, at Morowe Korle, not far from Adam's Peak. It is of the opaque, asteriated variety, known as "star-sapphire," which, if suitably cut—en cabochon—shows in the sunlight a beautiful, many-rayed star.

difficult for them to repress their mirth. I stood among a number of coffee-planters, not more than five yards from the relic, thus having as good an opportunity of inspecting it as I could wish for under the circumstances. No one—not even the Prince—was allowed to touch the tooth, or to approach it very close. The worthy Buddha must have had a wonderful set of teeth when he was among the living. The specimen here represented was at least five inches long, and was, of course, no human tooth at all, but the side tusk of a pig,—probably a wild boar,—somewhat yellow and discolored from age, like Siberian ivory. That the priests should have had the courage, or rather impudence, to bamboozle the benighted people with an ordinary pig's tusk, by representing it as a part of Buddha's masticating apparatus, and thus lead them by the nose for more than two thousand years, struck me as very singular; but it is really in no way different or worse than the swindle carried on even at the present day in numerous cathedrals and monasteries of Europe, where nails from the true cross, tears which Christ wept, pieces of Jacob's ladder, and, in one Bavarian cloister,[5] actually a bottle full of that darkness which came over Egypt (an ordinary brandy-flask, smoked inside with lamp-black), are exhibited and worshipped by superstitious and degraded multitudes.

Now with regard to this tooth of Buddha, I have my own special theory. I do believe that a real, human tooth,—and possibly of Buddha, who, there can be very little doubt, was an historical chararcter,—once existed in that temple, but became lost. In the "Mahawanso," the great historical record of the Singhalese, we read that the Tamils of the Malabar coast of India, about three hundred years before our era, made war upon the Singhalese, ravaged the island, and carried the tooth in triumph to India. But the Singhalese, burning for revenge, equipped a fleet, and a few years later invaded the Tamil country, never resting till they had recovered the precious masticator and brought it back to the temple at Kandy. This is stated to have actually happened twice, for the tooth was held in great esteem on account of its supposed virtues, and neighboring races were anxious to get hold

[5] The monastery of Banz, near Bamberg, in North Bavaria.

of it. Now I believe that in these wars and troubles the original tooth was lost, and that the priest substituted another, and, moreover, one of more respectable dimensions, which could be plainly seen from a distance, and which it was not so easy to lose.

Of course all this has nothing to do with the Buddhist religion. That religion is a grand and noble one,—a religion of tolerance and humanity, superior in many respects to Christianity. It forbids the destruction of life in any form, holding that every creature, down to the most despised insect, is in a sense sacred, and has as great a right to exist as man. Therefore the orthodox Buddhist carefully avoids the killing or molesting of animals; he will not even hurt a scorpion or venomous serpent, and is thus compelled to live entirely on vegetable food, chiefly rice. Many will not even drink milk, for fear of depriving the calf of its necessary nourishment, and the coffee-planters of Ceylon are obliged to hire Tamils as cooks, for no Singhalese will boil an egg, as it involves the destruction of the life within. Another of the reasons why they do not kill animals is because they believe in the transmigration of souls. They do not believe in a heaven such as the Christian pictures it, viz., a region of eternal bliss, or its opposite, a place of torment. The Buddhist philosophy is that a state of perpetual happiness is absolutely impossible; happiness ceases to be happiness the moment it takes the character of constancy. We are no longer happy when we have obtained what we were wanting, and, for similar reasons, a state of eternal misery is unthinkable. The only *possible* state of eternal bliss is the "Nirvana," the great culminating-point of Buddhism. This Nirvana is a state of indifference: the soul, freed from the body, feels neither pain nor joy, is oblivious of everything—not aware of its existence even—and to enter the oblivion of Nirvana is the chief aim of every Buddhist. The great world-soul, which gave us all our being, takes us back into its mysterious night. But to become worthy of Nirvana the Buddhist must lead a virtuous life, otherwise his soul after death, instead of going to Nirvana, enters another body, is born again, and compelled to face anew all the troubles and disappointments of life. This migration may continue for

centuries, or for millions of years, till the necessary degree of perfection is reached. Thus life itself, far from being an advantage, is looked upon as a state of suffering, and, even under the most favorable circumstances, as something neither to be envied nor desired.

I have found the Buddhist priests in Ceylon an exceedingly kind and worthy set of men. They live in the strictest celibacy, and in the most frugal and unpretentious manner. They are forbidden to own property, and must obtain their food by begging. In the Singhalese villages one may therefore see the priest every day with his begging-bowl, a cocoanut shell, collecting rice from house to house. The command is that nothing must be stored up, but every meal has to be specially begged for, and by means of this excellent provision the accumulation of wealth in monasteries, with all its corrupting concomitants, is successfully prevented. The priests dress in long yellow robes (yellow being the sacred color), with the right arm hanging out naked, and the left concealed within the folds of the garment. They go barefooted, bare-headed and closely shaven. I once asked an old priest for the origin of this custom of keeping their heads shaved. His answer was very remarkable: "Sahib," he said, "we follow in this, as in everything else, the example of our great master (Buddha). If we were to let our hair grow, we might occasionally be tempted to molest or kill certain small insects which, as you may have observed, are not of rare occurrence among, or rather *on*, the natives of this country. To avoid this we go shaved." Now the tonsure of the Roman Catholic clergy, along with many other rites and ceremonies of Catholicism, can be easily and unmistakably traced back to Buddhism whence they are derived, though I am somewhat doubtful as to whether Catholic priests will feel much flattered upon learning that the tonsure was merely inaugurated for entomological reasons, viz., in the sole and exclusive interest of parasites.

Looking at the position of Ceylon on the map, one would naturally conclude that the island was once connected with the mainland of India. Such was indeed the opinion held by geologists till comparatively recent years. It was taken for granted

that Ceylon had been separated from the peninsula either through the agency of currents or partial submersion. But modern investigations have disproved this, and it is now tolerably certain that Ceylon was never connected with India, but is one of the few remaining vestiges of a huge continent which stretched in almost boundless expansion to the south, far beyond the equator into the distant regions of the Pacific. The geological features of Ceylon are very unlike those of Southern India; the configuration of the mountains, the stratification of the rocks and their geological ages are quite different. In Ceylon we have a mountain region, rising more or less abruptly from the lowlands, and composed almost entirely of metamorphic rocks, chiefly gneisses, schists and slates, resting on an ancient granite. The formation is essentially Archæan: there is an almost total absence of any of the fossiliferous strata of the more recent periods, and an entire absence of Tertiary rocks. The only limestone found is an ancient dolomite of crystalline structure, in which every trace of organic remains — if ever existing — has been obliterated. Now most of the continent of Southern India consists of *recent* rocks, and it would seem that at the commencement of the Tertiary period the greater part of the peninsula was still covered by the sea, but that in the south a great continent extended eastward and westward, connecting Malacca with Arabia. The Himalaya range then only existed as a chain of islands, and did not, till a much later age, become elevated to its present proportions, a change which took place during the same revolution that raised the great plains of Siberia and Tartary. While these gigantic land masses slowly rose from the ocean depths the huge continent between the tropics underwent a simultaneous depression. This continent, in all probability, once connected the distant islands of Ceylon, Sumatra and Madagascar.

In Ceylon we find about 38 species of birds which are unknown in continental India, but these very birds occur in Sumatra, Borneo and others of the Sunda Islands. The insects of Ceylon are more closely related to those of the Malay Archipelago than to those of India. The elephant of Ceylon is *not* identical with that of India, but presents characteristics which are also pos-

sessed by that of Sumatra. The first to point this out was Prince Lucien Bonaparte (Proc. Zool. Soc. London, 1849), and Prof. Schlegel, of the University of Leyden, has since confirmed the identity of the Ceylon elephant with that found in the Lampongs of Sumatra. According to a Singhalese tradition, Ceylon, in a very remote past, formed part of a huge continent which connected Africa with China.

The precious stones, for which Ceylon has been celebrated from time immemorial, are found in the sand and gravel of the rivers. Most of these rivers — and Ceylon possesses quite a number of them — have their source in the central mountain district. The gems occur in a natural state as constituents of the garnetiferous gneiss, which is prominently developed in Adam's Peak, Newera Ellia, and neighboring points. The gradual disintegration of these gem-bearing masses, through aqueous and atmospheric agencies, leads to the freeing of the gems, which are washed out and precipitated along with other detritus by the mountain torrents during heavy rains, thus finding their way into the various river-beds, in which they roll for miles, and are gradually worn off or smoothed into roundish pebbles. The most celebrated of these gem-rivers is the Kalu-Ganga, which has its source near Adam's Peak, and flows into the sea about midway between Point de Galle and Colombo. On this river, and about twenty miles distant from Adam's Peak, is the ancient town, or Singhalese village, of Ratnapoora (literally, "the city of rubies.") Here is the headquarters of the Ceylon gem trade, so far as the native business is concerned; here gems have been dug, or washed out of the river mud for two thousand years, and here they are still found in the same profusion. The river in olden times appears to have been much broader, extending for more than a quarter of a mile beyond either of its present shores, and anyone digging within that region to a depth of six or seven feet comes to the so-called "gem gravel," viz., the ancient river-bed, in which are found rubies, sapphires, topazes, cats-eyes, garnets, cinnamon-stones,—in fact almost every known variety of gems except the diamond, which, so far as I know, has never yet been found on the island.

The desire for precious stones is very intense in the East, chiefly on account of their supposed inherent virtues. They are worn as charms by the superstitious—and what Oriental is free from superstition? Thus the greatest buyers are the wealthy high-caste natives, especially the Indian rajahs. They have their agents at every noted gem-mine, who have the picking of all that is found, and who eagerly buy up everything of exceptional value. No really fine gem—fine in an Oriental's eyes—ever goes to Europe or to this country, unless by accident. European traders and their agents cannot, with their paltry offers, compete with the Indian princes, who pay immense sums for fine stones to be set in their crowns, on their fans, their sword-handles, their turbans, their very slippers. European and American dealers have to content themselves with third and fourth-rate specimens, which they palm off as marvels of Oriental finds upon their unsophisticated customers. During my stay in Ceylon the celebrated pearl-fishery near Putalam, on the north-western coast of the island, which had been prohibited for more than thirty years to give the oysters a chance to grow, as they had been nearly exterminated by unscrupulous parties, was resumed for a period of six weeks. During that time more than seven thousand basketfuls of oysters were brought ashore, and quite a number of agents were on the spot ready to buy the pearls. Only four exceptionally fine pearls were found, which were all secured by the Maharajah of Jeypore, while the European agents had to do the best they could with inferior specimens, deformed, off-color, and seed-pearls.

The value of the gems and pearls possessed by some of these rajahs, and to be found in the treasure-shrines of the temples, is something fabulous. For a long time it was a puzzle to me how these chiefs and priests could have accumulated such immense treasures—for I was tolerably sure that they could not have all been paid for in money or any other equivalent. Finally I discovered the reason. It is well known that the natives of India, especially the Hindoos, are divided into castes. Of these castes there are, among the Hindoos, nominally four, but in reality more than twenty, which are strictly separated from each other in a

social sense, as if surrounded by invisible walls. There are the Sudras, the lowest of all, then the fishermen, jaggery-people, water-carriers, carpenters, and so forth, up to the Rajah. Now the very lowest castes are not allowed to wear any jewels whatever, and from the carpenters up to a certain caste they can only wear inferior stones, such as moonstones, carbuncles, amethysts, garnets, cinnamon-stones, etc., while some of the higher castes are allowed to wear rubies, sapphires and even diamonds up to a certain size, but all highly valued gems above a certain weight go to the Rajah, who alone may wear them, and any infringement of these rules is, or was, severely punished, not long ago even with torture and death. Thus, as a matter of course, the Rajahs obtained possession of all the fine stones found within their domains, at little or no expense. The priests, on the other hand, dominated over the Rajahs; they assisted them in their tyrannical rule by keeping up the illusion of the divine right of kings, pooled with them, and naturally came in for a share of the plunder.

RECENT BOOKS AND PAMPHLETS.

ALLEN, J. A.—Descriptions of New Species of South American Birds. Extract from *Bull. Am. Mus. Nat. Hist.*, Vol. II. From the author.

Boletin de la Academia Nacional de Ciencias en Cordoba. Diciembre de 1887. Tomo X. From the Academy.

BOULENGER, G. A.—An Account of the Reptilia obtained in Burma, north of Tenasserim, by M. S. Fea, of the Genoa Civic Museum. Extract from Annals of the Genoa Civic Museum.—An Account of the Scincoid Lizards collected in Burma, by Messrs. G. B. Cornotto and S. Fea. From the author.

Bulletin No. 4, Ohio Agricultural Experiment Station, 1888.

Bulletin No. 3, Hatch Experiment Station of the Mass. Agricultural College, 1887. From C. H. Fernald.

CARLSSON, A.—Zur Anatomie des Hyperoodon diodon. Bihang til K. Svenska, Vet. Akad. Handlingar. Band 13, Atd. IV., No. 7. From the author.

CLAYPOLE, E. W.—The Eccentricity Theory of Glacial Cold *versus* the Facts. Reprint from Edinburgh Geol. Soc., March, 1888. From the author.

COPE, E. D.—Synopsis of the Batrachia and Reptilia obtained by H. H. Smith in the Province of Matto Grosso, Brazil. Read before the Am. Phil. Soc., March 18, 1887.

COPPINGER, W.—Making a World. From the author.

CRAGIN, F. W.—Preliminary Description of a New or Little Known Saurian from the Benton of Kansas. Extract from *Am. Geol.*, Dec. 1888. From the author.

DAWSON, W. J.—On the Eozoic and Palæozoic Rocks of the Atlantic Coast of Canada. Extract from the *Quart. Journ. Geol. Soc.*, Nov., 1888.—On the Eozoic and Palæozoic Rocks of the Atlantic Coast of Canada, in Comparison with those of Western Europe and of the Interior of America. Reprint from *Quart. Journ. of the Geol. Soc.*, Nov., 1888.—Note on Balanus Hameri in the Pleistocene at Riviera Beaudette, and on the Occurrence of Peculiar Varieties of *Mya arenaria* and *M. truncata* in the Modern Sea, and in the Pleistocene. Reprint from the *Canadian Record of Science*, Jan., 1889. From the author.

DAWSON, W., and DAWSON, G. M.—On Cretaceous Plants from Port McNeill, Vancouver Island. Reprint from Trans. Roy. Soc. Canada, 1888. From the authors.

DEICHMÜLLER, J. V.—Die Meteoriten des Königleichen Mineralogischen Museums in Dresden. From the author.

FÖRSTER, B., und H. BECKER.—Über Schildkrötenreste aus dem Unteroligocän des Sundganes. Besonderer Abdruck aus den Mittheilunger der Commission fiir die Geol. Landes-Untersuchung von Elsass-Lothringen, Band I. From the authors.

GIARD, M. A.—Sur un Copépode (*Cancerilla tubulata* Dalzell), parasite de l'*Amphiura squamata* delle Chicago. From the author.

HAY, O. P.—The Northern Limits of the Mesozoic Rocks in Arkansas. Reprint from Vol. II. Annual Rep. Geol. Survey of Arkansas, 1888. From the author.

HARDEN, J., and HARDEN, ED.—The Construction of Maps in Relief. Extract from Trans. Am. Inst. Mining Engineers, July, 1887. From the author.

HENSHAW, S.—The Entomological Writings of Dr. Alpheus Packard. Bull. No. 16, U. S. Department Agriculture. From Charles V. Riley.

HILL, R. S.—Notes on the Geology of Western Texas. Reprint from the *Texas Geol. and Scientific Bull.*, 1888. From the author.

HUXLEY, T. H.—Observations upon *Hyperodapedon gordoni*. Reprint from *Quart. Journ. Geol. Soc.*, Nov., 1887.—Preliminary Note on the Fossil Remains of a Chelonian Reptile, *Ceratochelys sthenurus*, from Lord Howe's Island, Australia. Reprint from Proceedings Roy. Soc., Vol. XLII. From the author.

KEYES, C. R.—On the Attachment of Platyceras to Palæocrinoids, and its Effects in Modifying the form of the Shell. Read before the Am. Phil. Soc., Oct. 19, 1888.—The Coal Measures of Central Iowa. Extract from the *Am. Geol.*, Dec., 1888. From the author.

KUNTZ, G. F.—Waldron Ridge, Tenn., Meteorite.—Chatooga Co., Ga., Meteorite.—Hollow Quartz from Arizona—Taney Co. Meteorite, Mo. Extracts from *Am. Journ. Science*, Vol. XXXIV., 1887. From the author.

MEEK, S. E.—The Fishes of Cayuga Lake Basin. Reprint from the *Ann. N. Y. Acad. Sci.*, Vol. IV., 1888 From the author.

MENDENHALL, T. C.—On the Intensity of Earthquakes. Extract from Proceedings of Am. Ass. Adv. Science, 1888. From the author.

NEWTON, E. S.—Notes of Pterodactyls. Reprint from Proceedings Geol. Ass., Vol. X., No. 4. From the author.

NIPHER, F. E.—Isodynamic surfaces of the Compound Pendulum. Extract from Trans. St. Louis Acad. Sci., Vol. IV., No. 4. From the author.

PARKER, W. K.—On the Structure and Development of the Wing of the Common Fowl. Reprint from Philosoph. Trans. Roy. Soc., London, Vol. CLXXIX. From the author.

PACKARD, A.—On Certain Factors in Evolution. Reprint from *Am. Nat.*, Sept. 1888. From the author.

PUTNAM, F. W.—Palæolithic Implements. Extract from Proceedings Boston Soc. Nat. Hist., Vol. XXI. From the author.

Report of the Commissioners on Inland Fisheries and Game, 1888.

Report of the Michigan Forestry Commission, 1888.

RINGUEBERG, E. N. S.—Some New Species of Fossils from the Niagara Shales of Western New York. Extract from Proceedings Phila. Acad. Nat. Sciences, 1888. From the author.

SHUFELDT, R. W.—Further Studies in *Grammicolepis brachiusculus* Poey.—On the Affinities of *Aphoiza vigata*. Reprints from *Journ. Morph.*, Vol. II., Nov. 1888.—Notes on Brewster's and the Blue-footed Gannet. Extract from *The Auk*, Jan., 1889.—Notes on Horned Mammals. Reprint from *The Journ. of Comp. Med. and Surg.*, Jan., 1889.—Contributions to the Comparative Osteology of Arctic and Sub-Arctic Water-Birds. Reprint from the *Journ. Anat. and Physiol.*, Vol. XXIII.—The Navajo Tanner. Reprint from Proceedings U. S. Nat. Mus. From the author.

SMOCK, J. C.—Climatology of New Jersey. Extract from Report of State Geologist, Vol. I. From the author.

Supplementary Report of the Committee Appointed to Consider an International Language. Read before Am. Phil. Soc., Dec. 7, 1888.

SWINHOE, C., and COATES, E. C.—Catalogue of the Moths of India. From the Trustees of the Indian Museum.

WARD, L. F.—The Palæontological History of the Genus Platanus. Extract from Proceedings U. S. Nat. Mus., Vol. XI., 1888. Remarks on an Undescribed Vegetable Organism from the Fort Union Group of Montana. Reprint from Proceedings Am. Ass. Adv. Sci., Vol. XXXVII.—Asa Gray and Darwinism. Reprint from *The Historical American*, Aug., 1888. From the author.

WINCHELL, A.—Geol. as a Means of Culture. Reprint from *The Am. Geol.*, 1888. From the author.

WOODWARD, A. S.—Note on the Early Mesozoic Ganoid, Belonorhyncus, and on the Supposed Liassic Genus Amblyurus. Notes on some Vertebrate Fossils from the Province of Bahia, Brazil, collected by Joseph Mawson. Reprints from the *Ann. and Mag. Nat. Hist.*, 1888.—Contributions to Selachian Morphology. Extract from Proceedings London Zool. Soc., 1888. From the author.

General Notes.

GEOLOGY AND PALEONTOLOGY.

Description of a New Genus of Corals, from the Devonian Rocks of Iowa.—Of the fossil species occurring in the Devovian rocks of Iowa, many of them are as yet new to science, which fact is well shown by my own cabinet of fossils, personally collected from these strata. Also, many species which are described and have long been known to science are, in fact, but very imperfectly known. This is owing more particularly to the insufficiency of material heretofore obtained.

These statements are especially applicable to the coralline forms of nearly all divisions of this formation in the State.

In this paper will be found a description of a few of these corals from the Independence shale and the Rockford shales of Iowa.

Macgeea, n. gen.—Corals growing in solitary, cylindrical, sometimes compressed, cup-shape cells; usually from five mm. to forty-seven mm. in length, and calyx from one and a half mm. to eighteen mm. in diameter; slightly curved, externally irregular, usually showing evidence of attachment.

Calyx generally as deep as wide, but very rarely being only one-sixth as deep as wide; outer wall thin, rays numerous, from thirty-two to seventy-six in number, alternating in size within the cup.

Costæ (often very strong, and usually alternating in size) continuous with the rays over the edge of the cup and for some distance below the margin; lower down generally interrupted, or covered with a more or less epithecal coat (the epithecal coat is, however, sometimes entirely wanting), showing traces of numerous transverse partitions. Bottom of the cup large, and occupied by a slight depression; rays sometimes very slightly twisted in the bottom of the cup. The rays, and costæ for some distance below the margin of the cup, more or less distinctly denticulate on the edge.

The description of this genus is based almost exclusively upon the species *Pachyphyllum solitarium* of Hall and Whitfield, although made also to include *Macgeea culmula* of this paper. This genus differs conspicuously from the genus *Pachyphyllum* (to which the specimens upon which this generic description is based have been referred by

Hall and Whitfield), as will be readily seen by a comparison of the descriptions of the two genera. This genus is named in honor of Mr. W. J. McGee, of the United States Geological Survey.

Macgeea solitaria, H. and W.—*Pachyphyllum solitarium* H. and W., Twenty-third Annual Report of Board of Regents on New York State Cabinet, page 232. The specimens referred to this species are often quite available, and show several important features not mentioned in the original description. The denticulate character of the rays and costæ is most usually observed only in well-preserved specimens.

A critical examination of nearly two hundred specimens of this species reveals that the bottom of the calyx in well-preserved specimens is never occupied by a "slight elevation or columella" but, on the contrary, by a depression, as shown in Plate IX., Fig. 8, of the above-mentioned Report. This feature is the result of weathering.

Macgeea parva n. sp.—Coral single, very small, from five to six mm. in length, and from five to six mm. in greatest diameter; sometimes scarcely, and at other times sharply curved; subconical, but at times very strongly produced on the convex side of the cell, thus giving the calyx a distinct ovate marginal outline.

Calyx contracted at the top, about as wide as deep; outer wall of moderate thickness, bottom of the cup large. In the longitudinal section of a single specimen, the bottom was seen to be occupied by a very slight elevation; but whether or not this is a constant feature can be ascertained only by securing a larger number of specimens for examination than has as yet been obtained.

Costæ continuous with the lamellæ over the margin of the cup and for some distance downward; lower down covered by a smooth, perfect epithecal coat, sometimes annulated by fine striæ, of growth; lamellæ and costæ alternately large and small, sometimes slightly denticulate on the edge (the occasional absence of this feature is apparently due to attrition); from thirty-five to forty-two in number.

This species is closely related to *M. solitaria* of the Rockford shales, but differs from that species in its very small size, always continuous, perfect, and much smoother epitheca; the relatively thicker outer wall, as well as the strong constriction of the upper portion of the cell.

Position and locality: Blue shales below the Devonian limestone, Independence, Iowa.

Macgeea culmula, n. sp.—Coral small, elongate, cylindrical, slightly contracted and bent in the middle; externally somewhat irregular; calyx small, flattened at the bottom, width and depth about equal, outer wall thin; rays of moderate strength, from thirty to thirty-two in number. Costæ continuous with the rays over the margin of the cup, and for a short distance below; lower down interrupted or covered by a continuous, perfect epithecal coat. Costæ and rays alternating in strength; apparently denticulate on the edge. This feature, however, is not distinctly made out, owing to a slight erosion of the specimen.

The specimen in hand is attached nearly full length to a fragment of *Diphyphyllum*, although not a truly parasitic species. Dimensions: Diameter, four mm.; length, twenty-two mm. Position and locality: Rockford Shales, Hackberry, Iowa.—CLEMENT L. WEBSTER, *Charles City, Iowa.*

Pohlig on Elephas Antiquus.—Professor Pohlig, of Bonn, gives us the result of his investigations into the characters of *Elephas antiquus* (Falconer), in 260 pages quarto, and ten quarto plates. Especial interest attaches to this species as the ancient representative of the African elephant in Europe, and on account of its annectant character to the typical forms of the genus. Prof. Pohlig has successfully worked out its entire dentition, including the smallest milk-teeth, which are the rarest parts of Proboscidians to be found in collections. His material has been mainly derived from the museums of Germany, and of Italy. Particularly useful are his descriptions of the first deciduous molars, and the deciduous superior incisors. Towards the close of the memoir he gives his views as to the phylogeny of the species of Elephas. He will not admit that the Africanus group originated from the same type of mastodons as the others; he even believes that it descended from some pre-mastodont genus. We cannot assent to this view, as it is evident that the Tetrabelodons include the possibility of all the species of elephants.

Incidentally Prof. Pohlig expresses his views on other species of the genus Elephas. He thinks that a form preceded the *Elephas primigenius* in Europe which was intermediate in characters between it and the *E. meridionalis* (Nesti), which he calls *E. trogontherii*. He regards the *E. hysudricus* Falc. Cautl. as identical with the *E. meridionalis*. He regards the *E. militensis* Falc., *E. mnaidriënsis* Leith Adams, and *E. falconeri* Busk, as dwarf forms of *E. antiquus*, due to their restriction to the Mediterranean islands on which they have been found. He also defines a dwarf variety of the mammoth as *E. primigenius*

leith-adamsii, the remains of which are found in Germany, and are well represented in the museum of the University of Bonn.

The memoir is a most important contribution to a difficult part of the subject, and will be welcomed by all paleontologists.—E. D. COPE.

The Cretaceous Formation of S. W. Maryland.—For many years past the Tertiary formation of this section was an enigma which, under the light of the past, could not be satisfactorily resolved in accordance with the generally accepted theory that where the Tertiary formation was located, there was no other system to be looked for.

That idea has been a stumbling block that but few have been able to get over in a satisfactory manner.

The great cliff at Fort Washington, Prince George's county, has been to the author for the last twenty years a sealed book, an enigma not to be translated by any one, because, surrounded on all sides by Eocene deposits, it gave no sign of Eocene fossils, notwithstanding it stood up to an elevation of from 60 to 65 feet.

But recent ideas suggested by the work and labors of Prof. Wm. B. Clark, of Baltimore, have thrown off the confusion and made that locality readable. Visiting that formation recently we found evidences sufficient to put it down as Cretaceous. At this cliff we found Eocene shells scattered around—not in situ, but amongst the fallen débris—sufficient to prove it was once covered with the Eocene deposit, which is well developed higher up both Swan Creek on the north and Piscataway Creek on the south. We found both fossils, shells, and casts, plants and lignite in the cliff; one plant in my collection could be determined by an expert, from the leaves or parts of leaves which were collected.

A result of the examination of the cliff was the fact that we found it to rest upon a bed of variegated Jurassic clay, from one to two feet above high water mark, in which there is lignite. Further up Piscataway creek we found years ago large coprolites, pieces of bone, sharks' teeth, and palates of sharks, and amber, now in the possession of Mr. Philip Uhler, of Baltimore. We did not then know what these meant, but by the light of to-day we have to admit the formation to be, contrary to the generally received opinion, Cretaceous. The village of Piscataway is upon that formation. The old men of that place informed us that all the wells dug in that village since they could recollect, went down upon and into black micaceous sand and clay, and that they got water at from twelve to twenty feet. Traveling out from thence we found the Cretaceous clays covered with Eocene beds in

every direction; notably so in Bond's Retreat, Prince George county. The Cretaceous system is found in every deep washout or gully upon Mattawoman Swamp for ten miles above tide water; the same is true of all the swamps between the Potomac and Patuxent rivers, and doubtless beyond that river. Swainson's Swamp, the dividing line between Charles county and Prince George's county, gives Cretaceous clays overlaid by Miocene deposits; so does all that horizon. The Eocene and and Miocene can be found lapping the Cretaceous in all lower Maryland.

Given these facts, it is in order to ask; how is it that the Cretaceous has not been better worked up in this region; and why have the deep cuts failed to give us the remains of some old saurian,—such as Hadrosaurus or Lælaps. Such a discovery would round out the Cretaceous most grandly, and might bring us out upon the Jurassic with an interest hitherto unknown.

There have been already obtained in this deposit of Maryland from seventy to seventy-five species of fossil shells and casts of shells; but no fossil plants except the one noted in this paper.

We find but little to say upon the Cretaceous of the Virginia shore of the Potomac. We found upon examination years ago that the Acquia creek sandstone begins below Occoquan Bay, Fairfax county, Va., and runs out at Mt. Vernon, and that upon that formation nowhere upon the Potomac river could we find any other sign of the Cretaceous, except a deposit of very perfect leaves and stems at the White House —no black marl, no Cretaceous shells. That fact made the great cliff at Fort Washington more incomprehensible.

If our diagnosis is correct for the lower formation at Fort Washington—that it is Jurassic—then by a parity of reasoning that formation continues down at least to Smith's Point, Charles county, being occasionally lost below high water, and then rising from two to six feet above it.

In the upper end of Charles county, upon the Potomac river, opposite Mt. Vernon, there are three thousand acres of land, a plateau from one to twenty feet above high tide, surrounded with an amphitheater of hills in which Eocene and Cretaceous are well developed. In the plain below there is no sign of fossils, neither Miocene, Eocene, nor Cretaceous.

To what formation then shall we assign this locality? If not Jurassic —then, what is it? All the wells of this particular locality penetrate a variegated clay but no micaceous sand.—Oliver N. Bryan, *Marshall Hall, Md.*

PLATE XXXIII.

1. *Monoclonius crassus.* 2. *M. sphenocerus.*

The Horned Dinosauria of the Laramie.—Since my last note on this subject (AMERICAN NATURALIST, December, 1888, page 1108), the publication, by Professor Marsh, of a figure[1] of a skull of one of the species, enables me to determine more exactly the affinities of several species of the family which have been in my possession for many years.

The most complete skeleton in my collection is that of the *Monoclonius crassus* Cope.[2] This includes representatives of all the elements excepting the bones of the feet. The posterior part of the skull is preserved, including the left frontal bone. This bears a horn over the middle of the orbit, of small dimensions, and with the apex anteroposteriorly compressed. The parietal bones are enormously expanded, and are interrupted on each side of the middle line by a huge foramen, which causes the remaining parts of the bone to resemble the corresponding parts of Chamæleo, depressed in a horizontal plane. The squamosals are lateral, and consist of a wide plate with convex external border with a slightly undulating outline. The ilium is remarkably elongate, both anterior and posterior to the acetabulum, appropriate to the ten vertebræ which constitute the sacrum. It and the sacrum resemble very closely those of the *Agathaumas sylvestre* Cope,[3] which fact, with the evidence derived from the other vertebræ, leaves no doubt that the Agathaumas is to be referred to the family of horned herbivorous Dinosauria, with Monoclonius and Polyonax. This family is called by Marsh the Ceratopsidæ; but as it is not certain that Ceratops, Marsh, is distinct from one of the genera previously named, I shall call it the Agathaumidæ (or hellenicé Agathaumantidæ), from the longest known genus, Agathaumas.

The characters of Polyonax Cope are not yet fully known. The frontal horns of the typical species, *P. mortuarius*[4] Cope, are long and slender, while those of the known species of Monoclonius are shorter and robust, and there is a large nasal horn. The *Agathaumas sylvestre* is the largest of the species.

I now give a list of the species of this family known to me:

[1] *American Journal of Science and Arts*, December, 1889.

[2] Proceedings of Academy, Philadelphia, October, 1876. AMERICAN NATURALIST, 1886, page 154.

[3] Proceedings of American Philosophical Society, 1872, page 482; Cretaceous Vertebrata of the West, 1875, page 54, plates v, vi.

[4] Bulletins U. S. Geological Survey Terrs., 1874, April; Cretaceous Vertebrata of the West, 1875, page 63, plates II., III.

AGATHAUMAS SYLVESTRE Cope, l. c.

POLYONAX MORTUARIUS Cope, l. c.

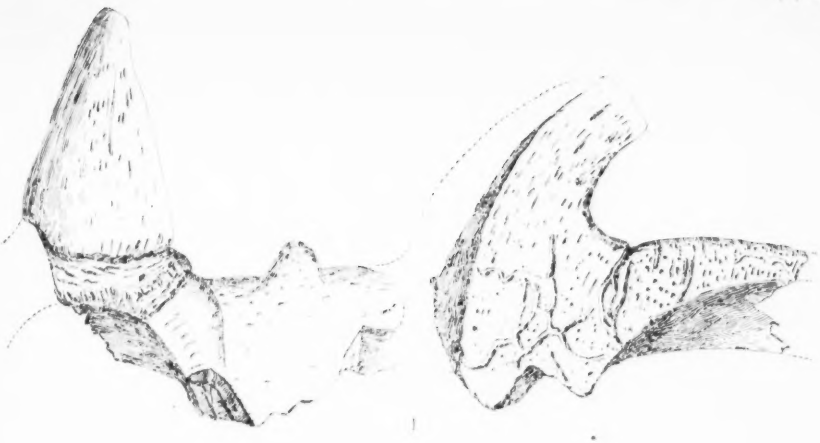
MONOCLONIUS RECURVICORNIS Cope, sp. nov. Dinosaurian Cope (Bulletin U. S. Geological Survey Terrs. III., 1877, page 588; plate 34, figures 7 and 8.)

I excavated the bones of the skull of this species in Montana, and described them as above; but suspecting that they might belong to some of the species already known, I did not name them. The fortunate discovery by Prof. Marsh enables me to determine them. The supraorbital horns are robust, straight, and rather short. Their section is an anteroposterior oval at base, and at the middle rounded subquadrate. The nasal bones are wedge-shaped and much narrowed forwards; they support a coössified median septum below. Superior face rounded, very rugose. Some distance posterior to the apex they support a very robust horn, which is compressed and turned abruptly forwards at the apex. Posterior face injured. Length of supraorbital horn 210 mm., long diameter at base 115 mm.; width of nasal bone at base of horn 100 mm.; diameter of nasal horn at base (transverse) 95 mm.; elevation (on curve) to broken apex, 115 mm. Between the supraorbital horns on each frontal bone a low tuberosity. This was a colossal animal and of peculiar characters. The squamosal is narrower than in *M. crassus*, and had marginal tuberosities.

MONOCLONIUS SPHENOCERUS Cope, sp. nov., represented by numerous parts of the skeleton, including parts of the skull, which were found by Charles H. Sternberg, on the Missouri River, near Cow Island, in 1876. The end of the muzzle is preserved, and presents characters which show that the species is quite different from the one last described. The nasal bones are greatly produced to form a slender, compressed, decurved apex, with a prolongation of the inferior median ethmoid septum. The superior face is round in the transverse section, and is rugose. At a long distance behind the apex the nasal horns rises. It is compressed and vertical in direction, and was not less than 250 mm. in length, but the apex I have not yet found in the packages. Supraorbital horns unknown. The nasal bones are narrower at the base of the horn than in the *recurvicornis*, and the horn is of different form. The anterior border converges regularly to the posterior, and its anterior edge is acute for the distal half. Length of nasals in front of horn, 255 mm.; transverse diameter of nasals below at base of horn, 70 mm.; diameters of base of horn, anteroposterior, 160 mm.; transverse, 60 mm.

PLATE XXXIV.

716



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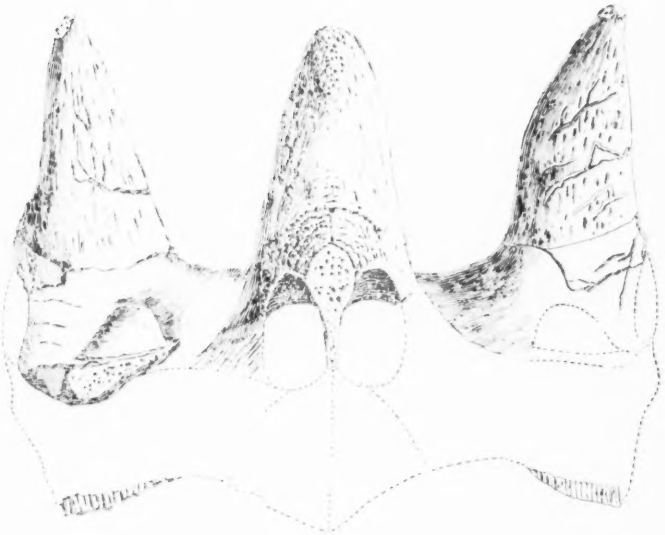

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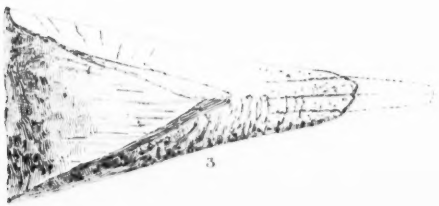

3

Monoclonius recurvicornis.

The *Monoclonius sphenocerus* is an animal of large size, exceeding the rhinoceros in height, and the nasal horn is the most formidable weapon I have observed in a reptile.

It may be that the two species last described belong to Agathaumus, as the cranial characters of that genus are not known.

MONOCLONIUS CRASSUS Cope, l. c. Parts of two individuals found together.

MONOCLONIUS FISSUS Cope, sp. nov.

Founded on a squamosal bone of an individual of much smaller size than those above described. The suture with the parietals is relatively shorter than in the *M. crassus*, occupying only the distal third of the margin. The plate anterior to the transverse suture for the quadrate is more nearly in one plane, is wider in relation to its length, and has a squamosal sutural surface, and a transverse groove not seen in the *M. crassus*. The excavation posterior to the process which joins the quadrate is deeper. External border mostly lost. Total length 180 mm.; length in front of quadrate suture 50 mm.; width in front of do. 87 mm.; width at postquadrate concavity, 62 mm.

EXPLANATION OF PLATES XXXIII. AND XXXIV.

Bones of Agathaumidæ much reduced.

FIG. 1. Parietal bone of *Monoclonius crassus* one-eighth natural size.

FIG. 2. Nasal and part of ? ethmoid bones of *Monoclonius sphenocerus; a* side view; *b* from above; two-ninths natural size.

FIG. 3. Part of frontal bone of *Monoclonius recurvicornis* with supraorbital horn, and nasals with horn; profile, two-ninths natural size.

FIG. 4. Front view of supraorbital and nasal horns and adjacent bones of *Monoclonius recurvinostris;* two-ninths natural size.

FIG. 5. Part of nasal bones of do. with part of median horn, from above; two-ninths natural size.

MINERALOGY AND PETROGRAPHY.[1]

Petrographical News.—An epitome of the various facts known to petrographers with relation to the act of crystallization in rock magmas, and the conditions under which this takes place, has been sorely needed by students who are unable to keep abreast of the widespread literature of modern lithology. Mr. Iddings[2] has recently succeeded in presenting the subject to us in a manner that is at the same time scientific and untechnical. His work will surely be appreciated by all of his co-laborers in petrography, as well as by students and geologists at large. Mr. Iddings' paper is divided into two distinct parts. In the first the phenomena of crystallization are discussed, with especial reference to the crystallizations of mineral in rock magmas. The second portion of the article deals with the causes of crystallization; and in this it is that the author has given the most valuable results. After mentioning the cases in which rocks and rock-forming minerals have been artificially produced, and calling attention to the analogy that exists between the originally molten rock-magma and saturated solutions of salts, it is concluded that (1) the order of crystallization in rocks depends primarily upon their chemical composition, and (2) its nature upon the physical conditions obtaining during the solidification; the principal physical conditions affecting crystallization, in the order of their importance, being temperature, rate of cooling, chemical composition of the original magma, the presence of mineralizing agents (aiding in the formation of crystals, *e. g.*, water in many rocks), and finally pressure. The effect of each one of these conditions is briefly alluded to, and the impression which each leaves upon the cooling magma during its progress from the interior of the earth to its surface is clearly described. In the course of the article the word *phenocrysts* is suggested as an equivalent for the German word "Einspringlinge,"—porphyritic crystals.—— The controversy between Prof. Judd and Dr. Geikie as to the origin of the massive rocks of the Western Isles of Scotland has been intensified by the appearance of Geikie's[3] "History of Volcanic Action During the Tertiary Period in the British Isles," and a reply to this by Prof.

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Maine.

[2] On the Crystallization of Igneous Rocks. Phil. Soc. of Wash. Bull., Vol. XI., pp. 65–113.

[3] Trans. Roy. Soc. Edinb. XXXV., pt. 2, pp. 21–184.

Judd.[4] It will be remembered that Judd,[5] in 1874, published an article in which was shown that there exist in the Western Isles of Scotland granites and gabbros, grading imperceptibly into vitreous pitchstones and tachylites, and emanating from five distinct centres, which were regarded as the seats of old volcanoes. The acid rocks of the region were regarded as older than the basic ones, and the district was thought to have been one of great volcanoes. In Dr. Geikie's monograph the last two conclusions are denied acceptance, while on the whole the first two are accepted. In his present article Judd gives his reasons for insisting upon the truth of his previous statements, and refuses to accept the view of Geikie that the great outbursts of lava took place from fissures (as in the Western States), rather than from volcanic vents. According to Judd the gabbros are the deep-seated portions of a magma, which, upon the surface, assumed the structure of basalt. This gabbro filled the fissures which were opened during the extravasation of the basalt, and is therefore contemporaneous with this rock. Geikie asserts that the gabbro injections belong to a distinct and later period than the outflow of the basalt. The controversy bids fair to yield results of great interest to petrography; for this reason it has been referred to in this place. The acid rocks of this region present some very interesting appearances, which are described by Judd[6] in a short paper. Granitic eruptive masses usually pass towards their peripheral portions into granophyres, smaller eruptive bosses and laccolites exhibit the granophyric structure throughout; while apophyses from intrusive masses display the same structures, sometimes on a very minute scale. A labradorite-andesite is composed of large crystals of labradorite scattered through a glassy base containing microlites of feldspar, augite and magnetite. In a specimen of this rock from Dun da Ghaoithe in Mull are large idiomorphic labradorite crystals, consisting of a central, sometimes rounded and corroded, core surrounded by an irregular fringe of the same mineral substance,[7] differing from the core in extinction and in other properties. This enlargement takes place only where the original crystal was in contact with the glassy matrix. The crystallographic continuity of the core and the surrounding envelope is shown by the passage of twinning planes from the one into the other; the optical

[4] The Tertiary Volcanoes of the Western Isles of Scotland. *Quart. Jour. Geo. Soc.*, May, 1889, pp. 187–219.

[5] Ib. XXX. [1874], pp. 220–302.

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differences by the extinction of the envelope in zones whose angle of extinction varies *gradually* and progressively from the centre outward, reaching finally (in some cases) the albite limit. This enlargement is regarded by the author as having taken place after the solidification of the rock, and at the expense of the glassy matrix. Further, the granophyric structure is supposed to owe its origin to a similar set of phenomena, viz., the secondary devitrification of a glassy matrix. A third very interesting article by the same writer[8] treats of the processes by which the plagioclase of the Oedegaarden "gepleckter-gabbro" has been changed into scapolite. In the fresh rock a labradorite with twinning lamellæ is distinctly observed. Along these twinning bands are accumulations[9] of cavities containing solutions of sodium chloride. As the rock loses its granitic structure and becomes schistose the feldspar loses its distinctive features, becomes granulated, and changes gradually into scapolite, at the same time losing its store of sodium-chloride solution. The production of the cavities with their contents of sodium-chloride is supposed to be the result of statical pressure — the solution having penetrated the mineral along its planes of easiest solution. Under the influence of mechanical stress the mineral was crushed and suffered granulation, reactions were set up between the feldspar molecules and the included sodium-chloride solution, resulting in entire conversion of the plagioclase into scapolite. The augite of the same rock presents a parallel series of changes. It first becomes schillerized, and then, by mutual reactions between the augite substance and the material producing the schillerization, is changed into hornblende. It is pointed out by the author that similar changes must have taken place in the Canadian scapolite rocks studied by Messrs. Adams and Lawson.[10] Prof. Judd would call the first kind of change "*statical metamorphism*," since the production of secondary cavities in minerals and schillerization are the result of solutions acting on mineral substances under the influence of heat and pressure. "Dynamical metamorphism," on the other hand, necessitates movement in the mass, with the accompaniment of the crushing of minerals and the production of schistosity. A comparison of the effects of the two kinds of metamorphism is briefly given by the author in a separate paper.[11]

[8] *Mineralogical Magazine*, VIII., pp. 186–202.

[9] cf. AMER. NATURALIST, 1887, p. 761.

[10] AMER. NATURALIST, Feb. 1889, p. 169.

[11] *Geological Magazine*, VI. 300, pp. 243–249.

A little south of Murfreesboro, in Pike county, Arkansas, is a mass of peridotite of Cretaceous age, whose microscopical features have recently been examined by Dr. R. N. Brackett.[12] The rock consists of porphyritic crystals of colorless olivine and brown mica in a ground-mass composed of lath-shaped crystals of augite, little crystals of peropskite and grains of magnetite in a decomposed yellowish glassy base. The rock is similar in many respects to the only other two peridotites described from the United States. It is placed by the author in the group of kimberlites or picrite-porphyries of Lewis. The ore-bearing rock at the Treadwell gold mine in Alaska is, according to F. D. Adams,[13] "A hornblende granite, much crushed, altered and impregnated with secondary quartz, calcite and pyrite." This includes kernels of more compact granite in which alteration has not proceeded so far. Much of the gold present in the rock occurs free in the pyrite. The rock is interesting in that it contains original epidote. Interesting intergrowths of the rare mineral allanite and epidote are described in some detail by Dr. Hobbs[14] in a porphyritic granite at Ilchester, Md., and by Lacroix[15] in the pyroxene-amphibole gneiss of Finisterre, in the pyroxene-wernerite gneiss of the Lower Australian Waldviertel, and in the scapolite-gneiss of Odegården in Norway. These intergrowths (in the Ilchester rock) consist of an idiomorphic core of brown allanite, zonally developed, and around it an idiomorphic or an allotriomorphic mantle of pale yellowish green epidote. In the allanite the axis of elasticity is inclined at an angle of 36° to the vertical axes, while in the epidote this is only 3°. Analysis of the purified epidote yielded Dr. Hildebrand:

SiO_2	Fe_2O_3.FeO	MnO	CaO	MgO	H_2O	P_2O_5	TiO_2
37.63	15.29	.31	22.93	.31	2.23	.44	3.78

Dr. Hobbs regards the epidote as secondary in the Ilchester rock, while Lacroix thinks it primary in all the occurrences described by him.

Mineralogical News.—In a short paper forming an appendix to his notes on the minerals occurring in the neighborhood of Baltimore, Dr. Williams[16] briefly mentions fifteen new species that have been

[12] *Amer. Jour. Sci.*, XXXVIII., July, 1889, p. 56.

[13] *American Geologist*, Aug., 1889, p. 84.

[14] *Amer. Jour. Sci.*, XXXVIII., Sept., 1889, p. 223.

[15] *Bull. de la Soc. Franc. de Min.*, XII., April, 1889.

[16] Johns Hopkins Univ. Circulars, No. 75.

identified in the region within the past two years. Among these is *ottrelite* from certain phyetites occurring at an old copper mine near Liberty, Frederick county. The crystals of the mineral are arranged nearly perpendicular to the cleavage planes of the rock. Their morphological and optical properties leave no doubt as to their true nature. In addition to the minerals described by Williams, Mr. Gill[17] describes two very rare chromium minerals found in the dump heaps of the chrome pits in Montgomery county. The first is a *chrome tourmaline.* This occurs in fissures in chromite, and is generally associated with *fuchsite,* both usually being imbedded in a chloritic matrix. The tourmaline is in the form of long dark green needles, exhibiting marked dichroism in green and straw-colored tints, and a beautiful zonal structure. The fuchsite is in little green scales, whose optical angle in air is 68° 16′ for sodium light, and pleochroism: A=robin's egg blue, B=yellowish green, C=bluish chrome-green. Analyses of the two minerals, made by Dr. Chatard, are given below. I. is that of the tourmaline, II. is the analysis of the fuchsite.

	SiO_2	B_2O_3	Fl	P_2O_5	TiO_2	Al_2O_3	Cr_2O_3	Fe_2O_3	NiO	CaO
I.	36.56	8.90	.06	.04	.09	32.58	4.32	.79	.05	.75
II.	42.21	. . . . .				34.55	2.03	1.03		.47

MgO		Na_2O	K_2O	H_2O	Sp.Gr.
9.47	I.	2.22	.13	3.74	3.062-3.089
3.13	II.	.82	9.16	6.77	. . . . .

Analyses and short descriptions of three other rare substances are communicated by Dr. Genth;[18] Gadolinite from Burnett and Llano counties, Texas, has a black color, is translucent in thin splinters, and has a greenish gray streak. Analysis of a specimen of the Burnett county mineral gave:

SiO_2	Al_2O_3	Ce_2O_3	ThO_2	$(Di.La)_2O_3$	$(Y.Er)_2O_3$	MnO	FeO
22.87	.28	2.65		5.22	44.35	.22	13.69

BeO	MgO	CaO	Na_2O	K_2O	Ign.	Sp.Gr.
9.24	.07	.64	.20	.15	.72	4.201.

Cacoclasite is the name suggested by H. C. Lewis for some tetragonal white crystals present in a blue calcite at Wakefield, Ottawa county, Quebec. Dr. Genth's analyses indicate that the substance is a mixture of several compounds whose nature cannot be determined. A

[17] Ib. p. 75.

[18] *Amer. Jour. Sci.*, Sept., 1889, p. 198.

monazite from the Villeneuve Mica Mine, Ottawa county, Quebec, has a reddish-brown color, slightly waxy lustre, and an indistinct cleavage. Analysis:

SiO_2	ThO_2	Fe_2O_3	Ce_2O_3	$(La.Di)_2O_3$	$(Y.Er)_2O_3$	MgO	CaO
.91	12.60	1.07	24.80	26.41	4.76	.04	1.54

P_2O_5	H_2O	Sp.Gr.
26.86	.78	5.233

Galmite and a *columbite* crystal from Delaware county, Pennsylvania, are also described and analysed by Dr. Genth.[19]

BOTANY.

The Cooke Herbarium.—From the June number of *Grevillea* we learn that the large herbarium of fungi, transferred by M. C. Cooke to the Royal Herbarium at Kew, is now for the most part incorporated with that great collection. The specimens are distributed as follows:

Hymenomycetes, about	11,000
Gastromycetes and Myxogasters,	2,000
Ustilagines and Uredines,	6,000
Discomycetes,	6,000
Pyrenomycetes,	12,000
Incompletæ,	9,000

The collection is a most valuable one, containing, as it does, contributions from many eminent mycologists, Berkeley, Curtis, Duby, Ellis, Fries, Leville, Montague, Peck, Ravenel, Rabenhorst, Winter, etc.

The Flora of Madagascar.—It may now be said with perfect truth that the vegetable productions of Madagascar have been, though not thoroughly, very extensively explored, and that the majority of the plants inhabiting the island are known to science. The country has been traversed by botanists in many different directions, its highest mountains have been ascended, its lakes and marshes crossed, its forests penetrated, and large collections of plants have been made from time to time, which have been examined and described in various publications. Our knowledge of the flora of Madagascar is due, in the first instance, to the labors of Flacourt, Dupetit Thouars, Commerson, Chapelier, Bernier, Lantz, Boivin, Pervillé, De Lastelle,

[19] Proc. Ac. Nat. Sc. of Phila., 1889., p. 50.

Grevé, Hilsenberg, Bojer, Goudot, Bréon, Vesco, Grandidier, Thompson, Lyall, Ellis, and others, most of whom collected plants chiefly in the east, north, and north-west parts of the island. * * * *

Within the last five years our knowledge of the flora of the island has been very materially increased, so that, whereas until recently less than two thousand species of plants were known, there are now named and described about four thousand one hundred, though many of them will doubtless prove repetitions when they are properly compared and worked out. * * * *

In Madagascar a considerable area is covered by primeval forests. On the eastern side of the island,—that is, the part eastward of the highest range of mountains, which forms the chief watershed,—there is a forest which extends probably eighteen hundred miles from north to south, almost, if not entirely, without a break, and which, if what is frequently stated be true, continues round the island, forming a complete, or almost complete, belt some distance from the sea. * * * *

It is grievous to relate, however, that the forests of Madagascar are being destroyed in the most ruthless and wholesale manner by the natives. Every year thousands of acres of country are cleared, the trees being burned to the ground, and that for no other purpose than to provide ashes as manure for a mere handful or two of beans, or a few cobs of Indian corn, or a little rice to be grown in the clearing. * * * *

The following figures will show at a glance the number of natural orders and generas of flowering plants represented in Madagascar as compared with those known throughout the world according to Bentham and Hooker's "Genera Plantarum":

Total known in the world, . . . Orders, 200; genera, 7,569.
Total known in Madagascar, . . Orders, 144; genera, 970.

Of the four thousand one hundred plants at present known in Madagascar, about three thousand (or three-fourths of the total flora) are, remarkable to say, endemic. Even of the Granicueæ and Cyperaceæ about two-fifths of the plants in each order are peculiar to the island. There is but one natural order confined to Madagascar, the Chlænaceæ, with twenty-four species, which, however, M. Baillon places under Ternstrœmiaceæ. Of ferns more than a third are endemic, and of orchids as much as five-sixths, facts which in themselves are sufficient to give å very marked individuality to the character of the flora. —Richard Baron, in *Jour. Linn. Society.*

Some Recent Botanical Literature.—In the August and September numbers of the *Journal of Botany* George Murray continues his useful catalogue of the Marine Algæ of the West Indian Region. —Mr. Buchanan White, in the September number, publishes a list of British willows, amounting to seventeen different speces, with many varieties and hybrids.—Britten and Boulger's Biographical Index of British and Irish Botantists has reached Lindsay. It is a most condensed index, and one wishes it could have been a little less so, especially in case of such men as Knight, Leighton, Lindley, etc.—A short obituary of the Rev. M. J. Berkeley appears in the September *Grevillea*. Born in 1803, he lived until the 30th of July of this year, reaching the ripe age of nearly eighty-six years. For more than half a century he was a careful student of the fungi. His herbarium, containing the types of about five thousand species, was deposited in the Kew Herbarium in 1879.—M. C. Cooke's new edition of his Handbook of the British Fungi has reached the genus Russula. The last species described is numbered 1214. Professor Underwood and O. F. Cook have compiled a generic synopsis of the Basidiomycetes and Myxomycetes covering twenty-one pamphlet pages. It is designed to accompany A Century of Illustrative Fungi, distributed by the authors.

BACTERIOLOGY.

Phenyl Alcohol as a Preservative for Growths of Bacteria on nutrient Agar agar.—While working on bacteria at the Illinois Laboratory of Natural History recently, the writer of this note made a few experiments with a view to finding something that could be used to preserve growths of bacteria in and on nutrient agar agar. Among a number of preservatives employed a thirty per cent. solution of carbolic acid in alcohol was finally settled on, as giving the most satisfactory results. The acid counteracts the whitening tendency of the alcohol to such an extent that the preserved agar agar is more transparent than the original. For very profuse surface growths it does not answer well, because the alcohol hardens, and renders them brittle, so that they are liable subsequently to flake off from the gelatine. Growths which have not been allowed to stand too long, however, before fixing, retain in the preservative much of their original appearance. The

alcohol used was the ordinary commercial article (in the neighborhood of 95 per cent.), and it may prove that a weaker grade, as likely to alter the gelatine less, will answer the purpose better.—H. GARMAN.

The Effects of CO_2 Upon Bacteria.—An important paper has recently appeared, by Dr. Carl Fränkel, on the influence of carbonic acid gas upon the life and activities of micro-organisms.[1] Fränkel was led to undertake this investigation by noticing that the deeper layers of soil, when freshly examined, contained very few germs, but after standing a few hours became prodigiously rich in bacteria. Thus, for instance, a sample of earth taken from the depth of three-and-a-half meters was found to hold in one-fiftieth of a cubic centimeter twelve living germs, but in twenty-four hours this number had mounted to 40,888. The question therefore arises as to why the micro-organisms existing in the lower strata of the soil do not thrive and multiply, since they are evidently in the presence of abundant and satisfactory food. Plainly there must be some influence in the sub-soil distinctly hostile to the development of the bacteria which are there present. Fränkel suspected that the unfavorable conditions might lie in the peculiar composition of the ground air, since this differs from ordinary atmospheric air in the smaller amount of oxygen and the much larger amount of carbonic acid which it contains. He has consequently studied the effects of carbonic acid upon micro-organisms with a view to clearing up this matter, and to throwing some light on the problems of putrefaction.

After giving the details of a series of skilfully conceived and carefully executed experiments, Fränkel briefly sums up his results.

1. A certain number of the known species of bacteria are able to thrive practically as well in CO_2 as in ordinary air.

2. Others, although able to develop in CO_2, have their growth delayed and hindered by its presence.

3. A third group does not grow in CO_2 under ordinary conditions, but develops when placed at the incubating temperature [35°-37°].

4. The greater part of the rest, including many saprophytic kinds, do not thrive in CO_2 under any conditions whatever, but are not, however, killed, and always develop when the CO_2 is replaced by atmospheric air, even after being subjected to the action of the CO_2 for a long time.

5. Some bacteria, among them the most important pathogenic kinds

[1] Die Einwirkung der Kohlensäure and die Lebensthätigkeit der Mikroorganismen. *Zeitschrift für Hygiene*, V. Bd., II. Heft, S. 332, 21 Nov., 1888.

(Cholera and Anthrax), are destroyed by the CO_2 more or less completely.

In spite of this influence of CO_2 in checking development, and in some cases in partially destroying the germs, it is not available as a means for preventing putrefaction, and is therefore not an antiseptic in the narrower sense of that term. A relatively insignificant admixture of ordinary air allows a rich development of even the kinds of bacteria most sensitive towards CO_2.

CO_2, then, for some micro-organisms is not an indifferent gas, but exerts a strongly inhibitory influence upon their multiplication, and in some cases destroys part of the germs submitted to its action. That this injurious effect is not due to the absence of oxygen is shown by the fact that a number of this group are anærobic in habit. For other kinds of bacteria CO_2 is apparently wholly inert.—E. O. JORDAN.

The New Science of Hygiene.—Whatever his opinions of the modern times may be in other respects every one must admit that the present contrasts most sharply with the past in its keen sensitiveness to the public welfare. Especially is this true of great cities, which have gone so far in this direction that it seems to be their highest endeavor to overcome the obstructions to the public health incurred by unnatural conditions such as density of population, and to work out for themselves new and better conditions of existence. A new root has sprung from the tree of knowledge, and hygienic science is shedding its light even in the darkest places, and civilized nations are hastening to meet this new necessity by the establishment of hygienic laboratories, yet at the same time it is but a one-sided view which regards hygiene as the handmaid of medicine only; on the contrary, it touches practical life in manifold ways of the utmost importance.—*Zeitschrift für Hygiene.*

ZOÖLOGY.

Excavating Habits of our Common Sea-Urchin.—The habit of certain species of sea-urchins of boring in solid rock is well-known, and has been again and again described, and made a subject of more or less extended study by naturalists. Although familiar with this work of the sea-urchins from descriptions and the study of specimens from other coasts, it has never been my good fortune to observe specimens of rock excavated by our species of Strongylocentrotus (*S. drobachiensis*) before the present summer. As other naturalists may have an interest to know of a place where this process can be readily seen, I have ventured to call their attention to the locality where it was observed.

The eroded rocks of the shore of Grand Manan and the sunken ledges about it offer exceptional features for the study of the phenomenon referred to, but even here it is rare and difficult to observe, although for miles and miles the bottom just below low tide is paved with these echinoderms. There are only limited localities where the excavating of these animals can be seen. One of the best places is on the Black Ledges, a few miles from Nantucket, Grand Manan. These ledges, wholly covered by high tide, are beaten at times by a tremendous sea, and around them course the violent tides of the Bay of Fundy. At low water they are bare ridges of rocks more or less covered with kelp, their surfaces with depressions in which standing water remains between low and high water. The sea-urchins in these pools lie so closely packed together that they touch each other, forming the bristling carpeting of their floors. In one of these pools these echinoderms have made excavations in the rock from one to three inches in depth, perfectly symmetrical and smooth, so close together that the rock has an appearance of the surface of honeycomb when the inhabitants of the cavities are removed. The rock in which these curious formations occur is a hard, gray slate, readily scratched with a knife, forming seams between the harder quartzite so prominent on many of the islands. The excavations are confined to the softer rock, and, as far as observed, were not seen in the quartzite. The sides of the basin in which they were found lie at an angle of about 80°, or almost perpendicular to the floor. The ridges which separate the cavities are tipped by a thick, calcareous, purple alga, which, while it may increase the apparent depth of the cavity as measured from the rim of the same, is comparatively thin as respects the depth of the excavation itself.

Near by this pool there are others with sea-urchins, apparently under the same conditions, where there is no sign of excavations, and long stretches of coast on the neighboring island, where the rock is perfectly paved with sea-urchins, show no attempt on the part of these animals to form even the slightest depression in the rock surface. The existence of these excavations is exceptional even in the Black Ledges, and the phenomenon is thought to be rare even on Grand Manan. Except that possibly the spines about the mouth were stouter than those found on sea-urchins which had not made the excavations, there is nothing to distinguish the inhabitants of the excavations from their neighbors. In no case was it found that the sea-urchins had sunken into the rock below its surface level, nor were the animals in any instance larger than the entrance of the cavities, or unable to escape from the holes in which they were found, as seen in so many specimens in our museums.

It is said by fishermen that our sea-urchins bore into the birch stakes used in building weirs, but I was unable to observe this phenomenon. In some places, however, the back and outer rings of the wood fibre was removed, apparently by them.

The one explanation of this work of the sea-urchins which an examination of the cavities suggests, is that they bury themselves in this way for protection, or for a more effective way of clinging to the cliff, but if such is the true explanation, why is the habit so localized and limited in area?

The method by which the cavities are hollowed out of solid rock is also a prolific subject for a theory, and many explanations have been advanced. I incline to believe that it is simply the effect of a mechanical erosion in the case of the Grand Manan specimens which were studied.

The rate of wearing of the holes is very slow, and there is reason to believe that many sea-urchins were concerned in the production of one excavation. The individual which at present occupies the cavity is probably the last of a series of several members, and the same may be true even when the sea-urchin is larger than the entrance to the chamber in which it lives. When the sea-urchins are removed from the cavities and the excavations uncovered a new tide will repeople them, so that there is little change in their appearance. The new denizens take up the work where their predecessors left off. This continued work, undisturbed for years, by successive sea-urchins, in time forms the cavities. Their own movements, and the wash of the sea,

possibly that of the tides, combine to file away the rock under their soft spines, which are renewed or replaced as time goes on.

It is instructive in connection with a mechanical explanation of the excavating habit of the sea-urchins to consider a geological phenomenon which the cavities inhabited by these animals at once suggest. The pot holes found between tides at certain points on Grand Manan are very beautiful examples of rock cavities worn by stones found within them. The general appearance of the sea-urchin cavities is much the same except in size and depth. The worn surfaces of the cavities are almost identical, and there seems no good reason why we should look for different causes in the two cases. All bowlders, even on apparently good positions, do not form potholes, as the majority of sea-urchins do not wear away a cavity for themselves, but in certain circumstances they do, and the result of the erosion is almost identical. It therefore seems as if it were far-fetched to bring in an acid secretion of the sea-urchin as an agent in forming these depressions in the rocks. It also seems as if the movement of the body did not wholly account for them, but that they are, in part at least, due to the erosion of the rock by the sea beating them against the rock surface, notwithstanding they are practically anchored by their feet.

I hope to be able later to present a more extended account of these sea-urchin excavations, accompanied by illustrations in which it will be possible to show the successive growth of a typical depression. What is here given, while it has a bearing on the deep cavities made in rocks by other species of echinoids, does not necessarily apply to them, but only to the excavations of *S. drobachiensis* found at Grand Manan.—J. WALTER FEWKES.

Moulting of Spiders.—M. Wagner (*Annales des Sciences Naturelles*, VI. 4, 5, 6), contributes an extensive review of the moulting processes which take place in the Arachnida. The writer does not confine himself to the formation of the new integument and the rejection of the old one, but treats also of the formation of the hairs, and the moulting of the eyes, respiratory organs, glands, intestines, and tendons, as well as the modifications observed in the blood-corpuscles during the process, and the biological phenomena which accompany the moulting. The interval between the old and new integument is at first filled with liquid, but this is absorbed before moulting. The new cuticle, unable to expand upon the thorax, forms folds, and the new hairs are held in tubes of the old cuticle. The old skin splits at the line of junction of the upper and lower parts of the cephalothorax, and

the members gradually free themselves from their sheaths, commencing posteriorly. This is the ordinary mode, but there are exceptions. The Tarantula (*Trochosa singoriensis*) passes through four moultings before commencing an independent life, and passes through several others before it attains full size. The author describes the peculiarities of certain genera. The hairs of an arachnid are produced from the lowest stratum of the cuticle, which rises in the form of a tube and perforates the upper layers, and are unicellular. The moulting of the eyes is confined to a comparatively sudden increase, the retina withdrawing itself from its envelopes. Sight is lost during the process, but it does not seem that that process in simultaneous in all the eyes. The moulting of the lungs is accomplished at once, and breathing is difficult during its duration, but the time occupied is short. Two of the three layers which compose the tracheæ are lost during moulting. The linings of the silk glands of the arachnids are shed, the broken parts of the old tubes remaining among the silk by which the arachnid is attached during the moult, and all glands formed by ectodermic invagination also lose their linings. The pharynx, œsophagus, and rectum take part in the moult, as do also the tendons, especially of the muscles of the limbs, the matrix growing around the old tendon and forming a new one, while the old one atrophies and is cast away with the tegument. During the operation of moulting the number of spherical corpuscles, which usually is only three to four per cent. of the total number of corpuscles, increases to ten per cent., almost all the colored corpuscles being transformed into spheres. Want of movement during the process seems to be one, but not the sole, cause of this change in the condition of the blood, and it must be remembered that a development of all the internal parts of the body takes place at the moulting period, so that the casting off of the teguments, etc., is really but a secondary act.

Some Arachnida seem to pass through the entire process of moulting easily, and take little or no precaution (many Thomisidæ, *e.g.*), while others, as many Attidæ and the adult Trochosa, take all possible precautions to shelter themselves from danger, since after the rejection of the tegument they are so feeble that an insignificant foe can master them. If a limb be detached immediately after a moult, it is renewed before the next moult, but if the loss takes place a short time before moulting, only a papilla is formed in the interval. Increased time is occupied in the moulting of adult individuals, and spiders do not moult in winter nor when deprived of nourishment for a considerable time.

Zoological News.—Cœlenterata.—Some points in the life history of the coral Fungia are given by Mr. J. J. Lister in the *Quarterly Journal of Microscopical Science.* When young, examples of *Fungia discus* and *F. dentata* are attached by a broad base and have vertical thecal walls. The youngest have six septa larger than the rest. After a varying height has been obtained, the upper part begins to widen out, forming at first a shallow cup with thecal walls facing outwards and downwards, and finally a disc depressed in the center, with the thecal walls facing directly downwards, the cup still remaining attached to the narrow stalk. After awhile absorption of the calcareous skeleton takes place at the junction of disc and stalk until the former falls off. At first there is a round scar on the centre of the free disc corresponding with a similar scar on the top of the stalk, the scar showing the thecal wall and sections of the septa, which latter unite with the trabeculæ that fill in the middle. The scar in time becomes covered, and finally all trace of it is lost.

The soft tissues are first exposed in the scar. The septa unite with the trabeculæ, which fill in the middle. In the disc there is no communication with the gastric region, except through the interspaces among the trabeculæ. The surfaces of the calcareous structures where absorption has taken place are white and opaque as compared with the general surface of the hard parts of the coral.

The first change visible in the stalk is that the septa throw up delicate fluted laminæ with serrated edges. A mouth is formed in the center, and the lips, in spirit specimens, seem almost in contact with the trabeculæ below. A thecal wall then springs up, usually a little within the margin of the thecal wall of the stalk. A new cup is thus formed, as the product of the structures in the base of its predecessor. As the walls grow they expand outwards, until a new disc is formed, and the former round of changes repeated. The stalk grows in height with each detachment, the place of every one of which is marked by a ridge.

Dr. von Lendenfeld thinks Fewkes' parasitic hydroid *Hydrichthys mirus* a Sarsia (*Biol. Centralblatt,* IX., p. 53). It is described in this journal (Vol. XX., p. 354).

Ortmann has been studying the stony corals of the Strasburg Museum, and gives some generalizations on their distribution. (*Zool. Jahrbuch,* Bd. III.) He says there are two faunæ,—an Indo-Pacific and an Eastern-American,—and these have only two species (*Heliastraca annularis* and *Siderastraca radius*) and nine genera in common,

and these nine genera are old Tertiary forms. He, therefore, thinks that the two faunæ have been distinct since the Tertiary. In the Atlantic he recognizes two divisions,—a West Indian and a Brazilian.

Worms.—The development of *Peripatus novæ-zealandicus* receives elucidation from Miss Lilian Sheldon in the *Quarterly Journal of Microscopical Science* for December. The eggs were removed from the uterus immediately after the mother had been killed with chloroform. Out of forty-five examples, twenty-two were males and nine females without ova: the others had from seven to eighteen eggs. The ovum is heavily charged with food-yolk. The development is antrolecithal, and the protoplasm is mainly at one pole. From the stages of development observed on embryos extracted in December, April, January, and July, Miss Sheldon concludes that the ova pass from ovary to uterus in December, and that the young are born in July.

Mr. F. E. Beddard (*Quart. Jour. Micr. Sci.*, Dec. 1888) has an article on certain points in the strutures of Urochæta, with especial reference to the excretory system of it and other earth-worms. The paper also includes a description of *Dichogaster damonis*, n. gen. et sp. The writer concludes with a review of the various modifications of the nephridial system found on earthworms, commencing with Perichæta, in which the nephridial network is continuous from segment to segment, and thus distinctly comparable with that of the Platyhelminths, and ending with Lumbricus, in which there is but a single pair of nephrida per segment. In Dichogaster (as in Acanthodrilus) the network of nephridial tubules is discontinuous at the septa, and the tubules are longer, less abundant, and occupy less space than in Perichæta. In Dichogaster the nephridia of the posterior segments are larger, and open by a single cœlomic funnel. In Dinodrilus some specimens show a slight connection from segment to segment.

Crustacea.—M. R. Koehler has studied the so-called scales of the peduncle of Pollicipes, and states that they are not comparable with those of the peduncle of Scalpellum, but have a peculiar and complicated structure, and are not properly scales. Their form is that of rectangles with rounded angles, and they are ranged in longitudinal and oblique lines upon the chitinous layer of the peduncle.

MM. A. Grird and J. Bonnoir have discovered a cryptoniscian isopod parasitic upon the amphipod *Angelisca diadema*. It is the first epicaridan that has been discovered upon an amphipod, and in its characters approaches *Cryptothiria marsupialis*. It has been named *Podascon dellevallei*. Not less curious is the discovery by the same

naturalists of *Aspidæcia nouveani*, a parasite upon a parasite, residing in the posterior part of the dorsal buckler of *Aspidophryxus sarsi*.

Insects.—From the researches of M. J. K. d'Herculais, it appears that the locust most to be dreaded in Algeria, and, in fact, in North Africa generally, is not *Acridium peregrinum*, the locust of the Bible, but *Stauronotus maroccanus*, an autochthonous species of different habits. *A. peregrinum* has its permanent home in Central Africa, probably in the region of the great lakes. Its subpermanent region is that part of Africa between the Sahara and its home, while the entire north of Africa is its temporary region, where it cannot maintain itself more than two years. This locust arrives in Algeria in April or May in immense flocks, couples soon afterwards, and the females deposit deeply in the earth, in damp spots, egg cases containing eighty or ninety eggs. Two months later the young appear, and continue the ravages commenced by the parents. In forty-five days they acquire wings, and take flight. *S. maroccanus* has a wide geographical distribution, embracing all the mountains and districts around the Mediterranean from Spain to the Caucasus. It is a lover of dry and mountainous districts. The winged adults appear in Algeria in July and August, and the females deposit at a slight depth, upon rocky and dry ground, notably upon hillsides with a southern or eastern aspect, egg cases containing thirty to thirty-five eggs. The young escape nine months afterwards,—*i.e.*, in the spring of the next year,—and become adult in sixty days. This species loves rugged and mountainous spots, and flourishes where the winters are cold and the summers hot; whereas *A. peregrimum* is a creature of the humid plains and valleys, and needs the heat of summer for its multiplication.

Fishes.—The salmon taken in the rivers of Finland are in many cases found to contain, in the throat or in the alimentary canal, a copper hook of a form unknown in Finland. Among three thousand fishes taken between the end of June and August, 1883, in a salmon-fishing establishment on the river Uba, twenty-five contained a hook of this kind, sometimes with a portion of the attached line. It is now known that these copper hooks are those used in the north of Germany, where the salmon fishery is chiefly carried on in the winter. Thus some of the salmon of the Finnish rivers descend in winter to the Baltic coasts of Germany. A sea fishery of salmon is also carried on upon the coasts of Sweden, and in the island of Bornholm. In the Baltic, as upon the Scotch shores, it is observed that the salmon usually seeks its food upon a sandy bottom. This marine fishery, which

in Bornholm alone produces some twenty thousand salmon, is carried on throughout the year, but is most successful in winter. M. Fendersen has shown that almost every river of Iceland has its peculiar form of salmon, and that each of these forms frequents, during its growth, the seas adjacent to its native river.

EMBRYOLOGY.

Notes on the Development of Ampullaria depressa, Say.—During last spring Mr. Jos. Willcox sent a lot of the large ova of the above-named species of this interesting genus from Florida to my colleague, Professor Leidy, who very kindly placed some of the material at my disposal for study. These ova were placed in the conservatory connected with the Biological School, where they underwent development in an apparently normal way, at the surface of the water in aquaria in which Algæ are kept. It was found that the egg must not be immersed in the water; if immersed they are apparently asphyxiated. This corresponds with what Mr. Willcox has related to me in regard to the habits of oviposition of this fresh-water mollusk; the parent animal creeping, according to his observation, to the surface upon the stems of water plants, and after having reached the portions of the plants which rise above the water, the large eggs are deposited in a single layer on the leaves exposed to the air. Whether a glutinous covering invests the freshly laid ova I was not informed; it is certain, however, that the ova are firmly secured by a transparent glutinous substance to the large leaves of the water plants upon which they are found. Each of the spherical ova adheres to this glutinous matter, and its inferior side rests in a concave depression on the adhesive matter which forms a pretty thick layer on the leaves over the area covered by a brood of eggs. The broods vary in number, and, if the lots which I had under examination were undisturbed before reaching my hands, they may reach the number of forty or more, lying in a group about an inch wide and three or four inches long. Semper found seventy to eighty eggs in a single brood of *A. polita*.

The color of the living ova is pinkish by transmitted, but lighter by reflected light, because of the white of the calcareous shell. The pinkish color is not due to the presence of any coloring matter in the sub-

stance the egg shell itself, but is owing to the reddish brown color of the albumen which invests the ovum proper.

The diameter of the entire ovum is about one-fifth of an inch. This measurement includes the secondary egg-envelopes, *i.e.*, the calcareous shell and the albumen. The ovum proper is quite small, measuring only two-thirds of an millimeter or one thirty-seventh of an inch in diameter.

The structure and physiological relations of the shell, albumen, air-vesicle and ovum are complex; quite as much so, in fact, as in the egg of the common fowl, from which Ampullaria is of course exceedingly remote. There is even a striking resemblance between the bird's egg and that of Ampullaria in a number of respects. These are found in the common feature of an air space, a peripheral more liquid and a central more viscid mass of albumen, in which the ovum is embedded in both cases. I have been unable, however, to make out distinct chalazæ in the eggs of Ampullaria.

The size of the youngest segmented ova was two-thirds of a millimeter, which is unusual for the egg of a gastropod and is not greatly exceeded by the ova of most forms; the more usual dimensions being far below this, though in some it is probably much greater, as in Bulimus, for example, judging from the size of the shell.

The great size of the egg makes it certain that development proceeds by epiboly, the germinal or animal pole of the egg being probably marked by a blastodisk at an early stage. The early stages, of course, were not observed by me, having been passed over long before the ova came into my possession. A very large yolk was present in the youngest stages and the yolk substance was homogeneous and not granular. The relations of the yolk and the development of the walls of the mid-gut are of considerable interest as revealed in sections of entire embryos.

The account given by Semper of the development of *A. polita* Derhayes, is very incomplete as respects the early stages. The entire egg of *A. polita* is much smaller than that of *A. depressa*, measuring only three millimeters instead of five as in the latter. But there evidently remains a large yolk mass, as shown by one of Semper's figures, in which there is also represented a hemispherical cap, the blastoderm probably, composed of vesicular cells. One of his figures, showing four blastomeres, gives one the impression at first that cleavage is total, but this view is irreconcilable with the next figure, and if I have understood his text properly he has recorded nothing which is in conflict with the conclusion that the segmentation was partial; since

there is a large yolk mass represented in all of his figures of the latter stages.

In other respects the development of *A. depressa* and *A. polita* are very similar. The mid-gut has its walls greatly thickened in both cases. This is due to the hypertrophy of its constituent endodermal cells, which are evidentally occupied, as shown in sections of the latter stages, with the work of appropriating the yolk which still dilates the intestine. The yolk is absolutely without nuclei of its own, and is brownish-yellow in color. The dilated portion of the intestine bulges the body-wall outward into a hump-like prominence between the edge of the young shell and the back of the head of the embryo. There is a simple ctenidium or gill developed in the pallial chamber, and the young paired "hepatic" diverticula are greenish in color. The foot bears an operculum on its dorsal side long before the young animal leaves the egg-shell. No teeth seem to be differentiated on the radula in the older larva, one and a half millimeters in diameter. The foot, and a slight fold above the mesopodium and between the latter and the head, are ciliated, as well as the thickened epidermis about the mouth and the tips of the tentacles. The muscular mass underlying the radula, the otocysts and eyes, are well developed. The latter show pigment at this time. The yolk in the intestine has in my oldest stages grown quite small in amount, and causes only a slight projection of the body wall behind and above the head. The whole embryo rotates within the reddish albumen in which it is embedded, on account of the action of the cilia covering the foot. From the dimensions of two-thirds millimeter the embryo grows until it fills out the whole of the space of five millimeters in diameter inclosed by the egg-shell. In the course of this process the albumen surrounding the embryo is probably swallowed by the young snail and appropriated by the hypertrophied amœboid cells of the intestinal wall.

The air-vesicle is always at the upper pole of the egg, and forms a lenticular cavity just within the calcareous shell. It doubtless has to do with the respiration of the embryo, and recalls in a striking way the *vesicula aeris* of the bird's ovum, except that it has a different position, and does not seem to be separated from the albumen by a membrane.—JOHN A. RYDER.

Development of Crangon vulgaris.[1]—Dr. Kingsley's third paper on the development of this crustacean has just been published. His general conclusions are interesting as pointing out the presence of

[1] Bulletin Essex Institute, Vol. XXI., 1889, plates I.–III.

structures indicative of wider or more general affinities with other Bilateralia. The summary given below is in his own words.

1. The arthropod egg is not to be regarded as centrolecithal and having a superficial segmentation, but as having a central segmentation, the blastoderm being formed by migration of the resulting cells to the surface.

2. The primitive groove in the arthropods is a modified blastopore, and the absence of invaginated entoderm in some forms is to be explained by Cope's and Hyatt's theory of acceleration and retardation.

3. In Crangon the anus occupies the position of the blastopore.

4. In Crangon and many other crustacea the young germinal area is actually larger than the much older embryo.

5. All of the appendages belong to the primitively post-oral series, and the appendages move forward more rapidly than the corresponding ganglia.

6. There are indications of segmental sense organs in every segment of the body.

7. The alimentary tract proper is nearly, if not entirely, formed from the proctodeal and stomodeal invaginations, the entoderm giving rise to nothing but the liver.

8. The green gland is mesodermal in origin, and belongs to the category of segmental organs.

9. The genital ducts are modified nephridia.

10. The nauplius is an introduced feature, and represents no adult ancestral condition in the crustacean phylum.

Development of Sepia officinalis.—M. L. Vialleton concludes in the *Annales des Sciences Naturelles* (Tome VI., Nos. 4, 5, 6), an important contribution to the knowledge of the early phases of the development of *Sepia officinalis*, illustrated by six plates.

The formative vitellus in the Sepia is reduced to a laminæ at the pointed end of the yolk, and in this laminæ, directly after fecundation, a germinative central disc can be distinguished The first plane of segmentation is meridional, and divides the disc into five equal parts. Two and finally four secondary meridional divisions finally divide it into eight unequal segments. The polar globules place themselves near the first furrow at some distance from the centre of the egg. These eight segments have the value of macromeres. In the fourth stage the two inferior segments are divided equatorially, the others meridionally, dividing off two micromeres, so that the blastoderm at this stage has fourteen macromeres and two micromeres. By a further bipartition,

the blastoderm comprehends twelve micromeres and twenty macromeres, eight of the former being parted from eight of the micromeres. By this method of parting off micromeres, the latter at the end of segmentation are more than three hundred in number, and form a plaque with the smaller micromeres in the centre. The peripheric zone of the blastoderm occupied by the macromeric segments or blastocones, becomes transformed into a special thin bed which intercalates itself between the embryo and the vitellus, and is called by Vialleton the perivitelline membrane. Meanwhile a division of the micromeres or blastomeres perpendicular to their height produces a deeper layer of cellules—a mesoderm. Thus the egg at this stage consists of: (1) the ectoderm, which forms a circular plate composed in its centre of a single layer of cellules, but around its edge of several layers, produced by delamination at the expense of the superficial layer. (2) Of the mesoderm (*pars*) represented by the deeper beds of the borders of the blastoderm; and (3) by the perivitelline membrane or primitive endoderm. The border of the blastoderm then parts into a clear portion which becomes the vitelline sac, and an interior embryonal area. By secondary determinations, the ectoderm afterwards furnishes additional elements to the mesoderm. The entoderm, usually formed at an early stage, does not show itself in the Sepia until the eyes and pallial folds have been sketched out, and its development is very rapid, and seems to be formed at the expense of the perivitelline membrane.

PSYCHOLOGY.

The Psychic Life of Micro-Organisms.[1]—M. Alfred Binet, one of the most eminent representatives of the French School of Psychology, has presented in the above work the most important results of recent investigations into the world of micro-organisms. The subject is a branch of comparative psychology little known; as the data of this department of natural science lie scattered for the most part in isolated reports and publications, and no attempt has hitherto been made to collate and present them in a systematized form.

[1] THE PSYCHIC LIFE OF MICRO-ORGANISMS. A Study in Experimental Psychology. By Charles Binet. Translated, from the French by Thomas McCormack, with a preface by the author written especially for the American edition. Chicago: 1889. The Open Court Publishing Company. Cloth, 75 cents. Paper, 50 cents.

M. Binet's researches and conclusions show, "that psychological phenomena begin among the very lowest classes of beings; they are met with in every form of life from the simplest cell to the most complicated organism." The author contests the theory of Prof. George J. Romanes, who assigns the first appearance of the various psychical and mental faculties to different stages or periods in the scale of zoölogical devolopment. To M. Binet mind is an aggregate of properties which exclusively pertain to living matter, the existence of which is seen in the lowest forms of life as well as in the highest.

Prof. Charles Richet contests this view in the *Revue Scientifique*, and maintains with Romanes, that the supposed exhibitions of consciousness in the Protozoa are merely reflexes of protoplasm.

M. Binet finds that the movements of many Protozoa when seeking food display evident design. He thus describes their actions:

"In a large number of animacules the prehension of food is preceded by another stage, the search for food, and in the case of living prey, by its capture. We shall not investigate these phenomena among all the Protozoa, but shall direct our attention especially to the ciliated Infusoria. Their habits are a remarkable study. If a drop of water containing Infusoria be placed under the microscope, organisms are seen swimming rapidly about and traversing the liquid medium in which they are in every direction. Their movements are not simple; the infusory guides itself while swimming about; it avoids obstacles; often it undertakes to force them aside; its movements seemed to be designed to effect an end, which in most instances is the search for food; it approaches certain particles suspended in the liquid, it feels them with its cilia, it goes away and returns, all the while describing a zigzag course similar to the paths of captive fish in aquariums; this latter comparison naturally occurs to the mind. In short, the act of locomotion, as seen in detached Infusoria, exhibits all the marks of voluntary movement.

"The hunter Infusoria are constantly running about in quest of prey; but this constant pursuit is not directed toward one object any more than another. They move rapidly hither and thither, changing their direction every moment, with the part of the body bearing the battery of trichocysts held in advance. When chance has brought them in contact with a victim, they let fly their darts and crush it; at this point of the action they go through certain manœuvres that are prompted by a guiding will. It very seldom happens that the shattered victim remains motionless after direct collision with the mouth of its assailant. The hunter, accordingly, slowly makes his way about

the scene of action, turning both right and left in search of his lifeless prey. This search lasts a minute at the most, after which, if not successful in finding his victim, he starts off once more to the chase and resumes his irregular and roving course.

"In constant pursuit of its prey, the *Leucophrys* seizes its victim by the two stout vibratile lips with which its mouth is armed, and swallows them alive and whole. The victims may be seen struggling and tossing about for a time in the interior of the Leucophrys's body, and afterward to expire slowly under the action of the digestive juices of the vacuole in which they have been enclosed. Placed in a medium well-stocked with small Ciliates, the Leucophrys have their bodies constantly crammed with victims swallowed in the manner above described. Like the other hunter Ciliates the Leucophrys does not espy its victims from a distance, and does not guide itself toward them. It simply darts about from right to left, every moment changing its direction. It thus increases its chances of coming in collision with its prey, and every time that one of its unfortunate victims falls in contact with its vibratile lips, it is seized, irresistibly drawn toward the mouth and swallowed within less than a few seconds.

"The prehension of food by the *Didinium* exhibits interesting aspects which have not as yet been observed in any other Infusory. M. Balbiani, in his first observations, had often been surprised at seeing animalcula that the Didinium had passed by without touching, suddenly stop as if violently paralyzed; whereupon our carnivorous specimen straightway approached and seized them with seeming facility. More careful examination of the Didinium's actions soon furnished the key to this enigma. If, while swiftly turning in the water, the Didinium happens in the neighborhood of an animalculum, say a Paramecium, which it is going to capture, it begins by casting at it a quantity of bacillary corpuscles which constitute its pharyngeal armature. The Paramecium immediately stops swimming, and shows no other sign of vitality than feebly to beat the water with its vibratile cilia; on every side of it lie scattered the darts that were used to strike it. Its enemy then approaches and quickly thrusts forth from its mouth an organ shaped like a tongue, relatively long and resembling a transparent cylindrical rod; the free, extended extremity of this rod it fastens on some part of the Paramecium's body. The latter is then gradually brought near by the recession of this tongue-shaped organ toward the buccal aperture of the Didinium, which opens wide, assuming the shape of a vast funnel in which the prey is swallowed up.

"There exist organisms which lead a life of habitual isolation, but which understand how to unite for the purpose of attacking prey at the desired time, thus profiting by the superiority which numbers give. The *Bodo caudatus* is a voracious Flagellate possessed of extraordinary audacity; it combines into troops to attack animacula one hundred times as large as itself, as the Colpods for instance, which are veritable giants when placed alongside of the Bodo. Like a horse attacked by a pack of wolves, the Colpod is soon rendered powerless; twenty, thirty, forty Bodos throw themselves upon him, eviscerate and devour him completely.

All these facts are of primary importance and interest, but it is plain that their interpretation presents difficulties. It may be asked whether the Bodos combine designedly in groups of ten or twenty, understanding that they are more powerful when united than when divided. But it is more probable that voluntary combinations for purposes of attack do not take place among these organisms; that would be to grant them a high mental capacity. We may more readily admit that the meeting of a number of Bodos happens by chance. When one of them begins an attack upon a Colpod, the other animacula lurking in the vicinity dash into the combat to profit by a favorable opportunity.

M. Binet compares the movements of the Protozoa in reproduction with those of the reproductive elements in the higher animals,—the spermatozoid and the ovum. He says:

"A remarkable circumstance in this connection is, that the copulation of the spermatozoöid and ovule is not without analogy to the copulation of the two animals from which they originated. The spermatozoid and the ovule, to some extent, repeat on a small scale what the two individuals perform in their larger sphere. Thus, it is the spermatozoöid that, in its capacity of male element, goes in quest of the female. It possesses, in view of the journeys it has to make, organs of locomotion that are lacking in the female, and are useless to it. The spermatozoöid of man and of a great number of mammifers is equipped with a long tail, the end of which describes a circular conical movement, which, together with its rotation about its axis, determines the forward motion of the spermatozoöid.

"The spermatic element, in directing itself toward the ovule to be fecundated, is animated by the same sexual instinct that directs the parent organism towards its female.

"In the higher animals the movements of the spermatozoöid that is endeavoring to reach the female exhibit a peculiar character which it

is important to emphasize: these movements do not appear to be directly provoked by an exterior object, as those of micro-organisms are; the spermatozoöid endeavors to reach an ovule which is frequently situated a great distance away; this is the case particularly with animals that fecundate internally,—with birds and mammifers. A fact that is important to mention in a general way is the length of road the spermatozoöid has to traverse before coming up with the ovule.

"Let us now follow the spermatozoöid in its journey to the ovule. It is known that the road it has to traverse is, in certain instances, extremely long. Thus in the hen the oviduct measures 60 centimeters, and in large mammifers the passages have a length of from 25 to 30 centimeters. We might ask ourselves how such frail and minute creatures come by a power of locomotion great enough to enable them to traverse so long a path. But observation discloses the fact that they are able to overcome obstacles quite out of proportion to their size. Henle has seen spermatozoöids carry along with them masses of crystals ten times larger than themselves, without appreciably lessening their speed. F. A. Pouchet has seen them carry bunches of from eight to ten blood-globules. M. Balbiani has attested the same fact. These globules, which have fastened themselves about the head of the spermatozoöid, have each of them a volume double that of the head. Now, according to Welcker, the weight of a globule of human blood is 0.00008 of a miligramme: allowing that the spermatozoöid has the same weight, we may then say that it is able to carry burdens four or five times heavier than itself."

EXPLANATION OF PLATE.

Fig. 1. Conjugation of *Chilodon cucullueus*. *A*, beginning of conjugation; *b*, mouth; *n*, nucleus; *nu*, nucleolus; *vc*, multiple contractile vesicles. *B*, division of the nucleolus into two segments, *nu' nu''*; the nucleus *n*, beginning to show signs of regression. *C* each of the two individuals in conjugation contains two nucleolar segments, brought near together, of which one probably comes from the individual opposite by course of exchange, and will fuse with the segment not exchanged to form a compound segment (Maupas). *D*, division of the segment into two portions, which grow to unequal sizes; the larger *nu* will become the new nucleus; the smaller, the new nucleolus of the new formation *nun*. *E*, the old nucleus *n* reduced to a small, pale and rumpled mass, is replaced by the new nucleus *nu*, near by which is seen the new nucleolus *nun*. (From Balbiani.)

Fig. 2. *Paramecium aurelia;* positions preliminary to conjugation.

Fig. 3. Gemmiform conjugation of the vorticellinæ (*Carchesium polypinum*). *A*, firs stage; the microgonidium *nu* has fastened itself by a filament upon the peduncle of the

macrogonidium. *B*, a more advanced stage; the microgonidium has fastened itself directly on the body of the macrogonidium, and its substance begins to penetrate into the latter. In both individuals the nucleus has separated into small rounded fragments, and in the microgonidium are seen the two striated segments resulting from the division of its nucleolus. *C*, last stage of the conjugation. The microgonidium, completely void of its contents, remains attached to the body of the macrogonidium under the form of a minute hollow tube, which in the end drops away;—*ma*, macrogonidium; *mi*, microgonidium; *n*, nucleus; *nu*, nucleolus; *vc*, contractile vesicle. (From Balbiani.)

Fig. 4. *Stentor cæruleus* fixed upon a conferva filament, enlarged fifteen diameters. (From Balbiani.)

Fig. 5. *Stylonychia mytilus*, in position preliminary to copulation. The individuals are in contact by their ventral faces. (From Balbiani.)

MICROSCOPY.[1]

Kultschitzky's[2] Methods of Staining the Central Nervous System.—The tissue, having been hardened in Müller's fluid, or preferably in Erlichi's fluid, imbedded in celloidin, and sectioned, is allowed to remain in the stain from a few minutes to several hours. The first solution of hæmatoxylin is made as follows:

Boracic acid (saturated sol.)	20 ccm.
Water (distilled)	80 ccm.
Hæmatoxylin	1 g.

The hæmatoxylin should be dissolved in a small quantity of alcohol, and then mixed with the boracic acid and water. The resulting fluid will at first be yellow, but in two or three weeks it will change to a dark yellowish red. *Before using, the solution should be acidulated with a small quantity of acetic acid*, two or three drops in a watch-glass being sufficient. After the sections have been in the stain fifteen minutes, the medullated fibres are found to be of a dark violet or blue, while the other elements are of a light yellow or yellowish red. If the sections are allowed to remain longer, from eighteen to twenty-four hours, an intense differential stain results.

[1] Edited by C. O. Whitman, Clark University, Worcester, Mass.

[2] *Anat. Anzeig.* IV., No. 7, 1889, p. 223.

PLATE XXXV.

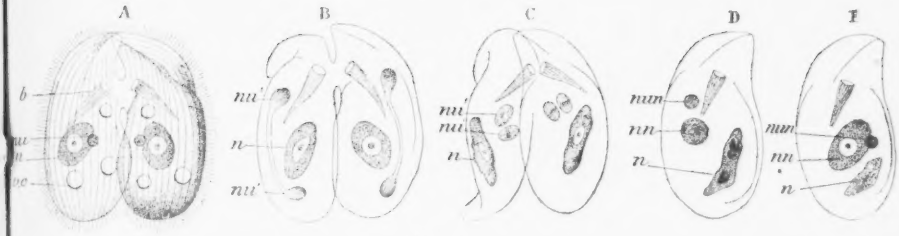


FIG. 1.

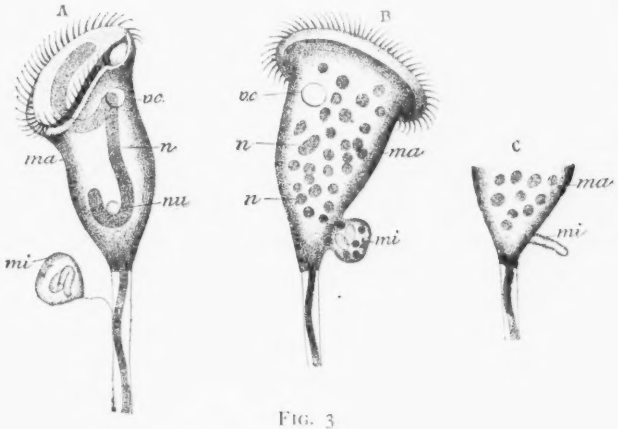


FIG. 3

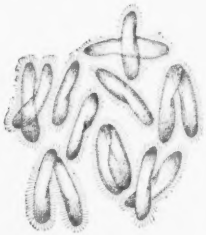


FIG. 2.

FIG. 4.

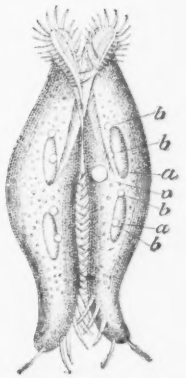


FIG. 5.

When the desired grade of staining is reached, the sections are washed in alcohol, and mounted in Canada balsam.

Still finer results may be obtained if the sections, after lying some time in the stain, are placed in a saturate solution of sodium or lithium carbonate, for twenty-four hours.

The following method will give quite the same results as the above, and is used more easily.

Acetic acid (2 per cent. solution) . . . 100 ccm.
Hæmatoxylin (dissolved in alcohol) . . . 1 g.

A Simple Method for Removing the Gelatinous Layer from the Batrachian Egg.— Professor Blochmann[3] recommends the following as a quick and safe method for treating large masses of frog eggs :

The spawn, having first been hardened in chrom-osmic-acetic acid, and then thoroughly washed in water, is placed in a beaker partly filled with dilute Eau de Tavelle (from three to four parts water), and gently agitated, that the fluid may reach all parts. In from fifteen to twenty minutes, according to the strength of the fluid, the glairy layer and the underlying membrane are dissolved, and the free eggs rest upon the bottom of the vessel.

At this point special care must be taken lest the eggs become injured by striking each other. The fluid being poured off, the eggs are carefully washed with water and placed through successive grades of alcohol.

If the material thus prepared is not made use of at once it should be kept in a dark place to prevent the further withdrawing of the chromic acid.

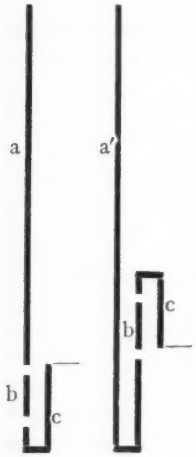
Eggs prepared in the above method stain nicely in borax carmine.

This method of Blochmann's is the same as that recommended by Whitman in June, 1889 (*vide* this journal).

The Differentiator Modified from report read before the British Association, September 11, 1889, at Newcastle, Eng. —According to the nature of the fluids in use, the differentiator takes one of the two forms here illustrated. As will be seen, a or a′, the reservoir, b, the object-cylinder or object-box, and c, the filter, are three pieces of glass tubing joined together by means of caoutchouc tubing, the lat-

[3] *Zoolog. Anz.* XII., No. 307, May, 1889, p. 269.

ter for the sake of clearness *not* shown. The filter, c, is easily made a follows: take a piece of glass tubing twice the length of the required filter, heat it red hot, draw it out to arm's length and break it in two; remove all the capillary part except about three inches on each half, heat, and bend into the required form (c); next carefully heat the capillary portion in a small alcohol flame, draw out exceedingly fine, and break off so as to leave a minute orifice.



To use the differentiator, proceed as follows: Suppose objects fixed by corrosive sublimate are to be studied in balsam after staining with borax-carmine. Fill the filter with sublimate solution and insert a plug of cotton (previously boiled in water to remove the air) at the U-bend. Join the object-box to the filter, fill up with sublimate solution, and push a plug of cotton into the lower end of the box, avoiding bubbles. Wrap the cotton in fine linen if the subjects are minute. Put the objects into the box, plug the upper end in the same manner as the lower end, and finally join the box and filter thus filled to the empty reservoir a, and hang the instrument up in the position here illustrated. The objects are now transferred to 33 per cent. alcohol in the following manner: mix equal parts of sublimate solution and 33 cent. alcohol (call this mixture 2). Mix equal parts of 2 and sublimate solution (call this 1). Mix equal parts of 2 and 33 per cent. alcohol (call this 3). Add mixture 1 to the reservoir until it is one-fourth full, mixture 2 until it is half full, mixture 3 until it is three-fourths full, and then fill up with 33 per cent. alcohol. If the successive mixtures are added with sufficient care, they will, owing to difference in specific gravity, remain distinct. If forced rapidly in, a nearly uniform mixture of about equal parts sublimate solution and 33 per cent. alcohol will result. The desirable procedure lies between these two suppositions, and gives rise to a uniform gradation of *differentiation from sublimate solution to 33 per cent. alcohol in passing upwards through the reservoir.* The flow, which at once commences drop-wise from the point of the filter, should be so regulated, either by tipping the instrument, or by breaking off more or less of the capillary part of the filter, as to cause the reservoir to be emptied in from two to five hours, when the objects will of course be in 33 per cent. alcohol, hav-

ing been *guarded to the utmost* against diffusion currents. They are now to be transferred to borax-carmine, a fluid *heavier* than 33 per cent. alcohol, by the use of reservoir a′. Fill the long arm of the reservoir with borax-carmine, and cork it, leaving the short arm empty and open. Mix equal parts of carmine and 33 per cent. alcohol (call this mixture 2). Mix equal parts of 2 and carmine (call this 1). Mix equal parts of 2 and 33 per cent. alcohol (call this 3). Add mixture 9 to the short arm of the reservoir until it is one-fourth full, mixture 2 until it is half full, mixture 3 until it is three-fourths full, and fill up with 33 per cent. alcohol. Transfer the object-box and filter to a′, avoiding bubbles, and uncork the long arm. The flow begins as before, but this time *upward* through the object-box, and the object-box, and the objects are thus transferred in from two to five hours to borax-carmine.

After staining, the objects are transferred to 30 per cent. alcohol by means of reservoir a, the flow being so regulated that the change takes place in from five to ten hours. Then change successively to acidulated 70 per cent., 90 per cent., and absolute alcohol, allowing five, or better, ten hours to each change. Transfer to turpentine, chloroform, oil of cloves, or any oil desired by reservoir a′. Finally to thin balsam, *still by means of the differentiator.*

Whenever the objects are to be transferred to a lighter fluid, use reservoir a ; whenever they are to be transferred to a heavier fluid, use reservoir a′. If objects are to be transferred to glycerine, transfer first to 50 per cent. glycerine in twelve hours, and then to pure glycerine in twenty-four hours.

Objects which defeat successful fixation by untimely contractions may be rendered insensible by means of the differentiator, and then fixed *perfectly outstretched.* Transfer them to alcohol of from 5 to 30 per cent. (or other paralyzing solution such as chloral hydrate) in from two to three hours, when they will be insensible and outstretched, and may be fixed as desired. A specially large object-box is easily contrived for larger specimens.

The differentiator, already in extensive use, was recently invented at Naples to overcome shrinkage and contraction in Anguillulidæ, and has speedily recommended itself for a great variety of delicate organisms, such as diatoms, desmids, and other delicate algæ, moulds, pteropods, and all sorts of embryological material, and takes its place at once as a permanent and very valuable addition to the paraphernalia of the biologist.

SCIENTIFIC NEWS.

Dr. W. J. Vigelius, well known for his researches on the anatomy and embryology of the Polyzoa, died at the Hague, December 3, 1889.

Dr. G. C. Vosmaer is no longer at the Naples Zoölogical Staton, but may be addressed at the Zoölogical Laboratory, Utrecht, Holland.

Dr. Franz Johon, recently privat-docent in Bonn, has been called to the chair of botany and zoölogy in the Normal School of Santiago, Chili.

Prof. Hemrecatt, the Nestor of French botanists, died in Paris, December 23, 1889, at the age of 91 years.

Prof. R. A. Philippi, of Santiago, Chili, celebrated his 80th birthday on the 18th of September last.

Mr. Charles L. Flint died in Boston, February 26, 1889. He was born in Middleton, Mass., May 8, 1824, and was appointed Secretary of the Massachusetts Board of Agriculture in 1853, holding the position for twenty-five years. While Secretary he issued the second edition o Dr. Harris's "Injurious Insects," and published a series of annual reports which from either scientific or agricultural aspect have not been excelled in this country. He was influential in the establishment of the Massachusetts Agricultural College, and the Institute of Technology.

M. Suchetet, professor at Rouen, France, would be very much obliged to any person making known to him the hybrid animals they possess or have observed in other places, living or stuffed.

Dr. Victor Signoret, one of the most prominent students of the Hemiptera, died at Paris, April 3, 1889.

Dr. H. A. Mayer, who with Karl Möbius was engaged in the study of the Fauna of the Gulf of Kiel, died at Forsteck, May 1, 1888.

Dr. G. Ruge, of Heidelberg, is the successor of Dr. Max Fürbringer, at Amsterdam.

Several deaths of naturalists have escaped notice in these pages at the time. Among these are those of Giovanni Bellonci, the anatomist, died at Bologna, July 1, 1888; Henry Stevenson, an English ornithol-

ogist, died at Norwich, August 18, 1888; Johann Kriesch, professor of zöology in the Budapest Polytechnicum, died October 24, 1888; Churchill Babbington, an English botanist and ornithologist, died January 12, 1889; Bellier de la Chavignerie, a French entomologist, died September 27, 1888; Richard S. Wray, an English student of the morphology of birds, died February 12, 1889.

M. Fernand Lataste has left Paris to accept the position of Director of the National Natural History Museum, and Professor of Zoölogy in the medical school at Santiago, Chili.

Dr. J. W. Van Wijhe, of Freiburg, has been appointed ordinary professor of anatomy in the University of Groningen.

Prof. Guiseppe Meneghini died in Pisa, January 29, 1889. He was born in Padua, July 30, 1811, and held for nearly thirty years the professorship of physics, botany and chemistry in the university there. In 1848 he was called to the chair of geology in the university at Padua, a position which he held at the time of his death.

The Late Xenos Y. Clark.—Xenos Young Clark, well-known on the Pacific Coast as well as in Massachusetts, died on the fourth day of last June at the residence of his mother in Amherst, in the latter State. He was the son of Prof. Henry James Clark, who died in the same place on the first of July, 1873.

The father first became known to the scientific world as a very promising student of the late Prof. Asa Gray. He was afterwards and for several years associated with Prof. Louis Agassiz as an assistant, and in 1860 became adjunct Professor of Zoölogy at Harvard College; after this he was connected with the Agricultural College of Pennsylvania, the University of Kentucky, and in 1872 with the Massachusetts Agricultural College at Amherst. He was a large contributor to the late Prof. Agassiz's volumes on the Natural History of the United States, and was also the author of various papers, memoirs, etc. His volume "Mind in Nature," the result of his micro-physiological studies, published in 1865, an imperial octavo of over 300 pages, and his memoir on "The Lucernariæ and their Allies," a quarto of one hundred and thirty pages and several plates, forming number 242 of the Smithsonian Contributions to Knowledge, etc., are perhaps his chief works; the latter appeared in 1878.

Xenos, the son, was born in Boston in May 1853, and studied in the preparatory department of the Kentucky University at Lexington,

and graduated at the Massachusetts Agricultural College in 1875. He went to California the same year, and entered the University of California at Berkeley, as a special student in Natural History, and soon afterward received the appointment of student assistant in natural history and geology, and preparator for Prof. Joseph LeConte. He was at various times a draughtsman in the office of the Surveyor-General of the United States, in San Francisco, and was also Curator of the San Francisco Microscopical Society, and lectured on microscopic zoölogy at this time. During his residence in California he also taught in the public schools. In 1879 he went to Europe, and studied for several months in Leipzig. Since 1880 he has resided part of his time in California and partly in Massachusetts, his health being very poor. During these latter years he has frequently contributed to the leading magazines, scientific publications, and weekly papers, including *The Nation*, *The Open Court*, etc., and THE AMERICAN NATURALIST. The latter for April 1879 contained a highly interesting article by him on "Animal Music: its Nature and Origin." He inherited much of his father's genius and ability; he was artistically skilful with the pencil, and his communications to the public exhibit a cultured and philosophic mind, which needed only a more robust physical body to command a prominent position. He was regarded as one of the most brilliant and popular students in college, and took a high rank in his scholarship. At the time of his death, which was attributed to Bright's disease and some affection of the heart, he was only 34 years old, and was connected with the Massachusetts Agricultural College at Amherst.—*R. E. C. S.*

Clark University, Worcester, Mass.—The following is the preliminary announcement of the Department of Biology:

ACADEMIC STAFF.

C. O. Whitman, A.M., Ph.D., acting professor of Animal Morphology.[1]

Warren P. Lombard, A. B., M. D., assistant professor of Physiology.

Franklin P. Mail, A.B., M.D., adjunct professor of Anatomy.

Henry H. Donaldson, A.M., Ph.D., assistant professor of Neurology.

[1] Editor of the *Journal of Morphology*.

ANNUAL APPOINTMENTS.

J. Playfair McMurrich, A.M., Ph.D., Docent in Animal Morphology.

C. F. Hodge, A.B., Ph.D., fellow in Neurology.

H. C. Bumpus, A.M., fellow in Morphology.

F. Tuckerman, A.B., M.D., fellow in Anatomy.

Other annual appointments are under consideration, and scholars, fellows and docents in this department may be designated and students may be received up to November 1. Only special students can be received later.

FORESTAL AND AGRICULTURAL EXHIBITION AT VIENNA.

To the Editor of the AMERICAN NATURALIST:

DEAR SIR:—I beg to announce that the Imperial Royal Agricultural Society of Vienna, will hold there in the year 1890 a *General Forestal and Agricultural Exhibition.*

It will take place in the Rotunda and the adjoining park grounds of the Prater, and will last from the fifteenth of May to the middle of October, perhaps to the first of November. The aim is to exhibit a complete picture of the present standing of all branches relating to agricultural and forestal efficiency.

The management of the undertaking is in the hands of a general committee especially selected for the purpose. The programme issued by this committee contains the following divisions intended for international participation.

Machines and implements for agriculture and forestry and their industries; for horticulture, orcharding, vinticulture, and hop culture; for the breeding of poultry and bees, and the keeping of silk-worms; for dogs, and the art of hunting and fishing.

Auxiliary means employed for farming, viz.: artificial manure, food produced for the market, of veterinary products, etc.

MODELS, PLANS, DRAWINGS, AND STATISTICAL DATES.

(*a.*) Of agricultural and forestal works of melioration and engineering.

(*b.*) Of the system of agricultural and forestal instruction and experimenting, literature included.

(*c.*) Of the use and sale of the waste matter.

(*d.*) Of the support of large cities with provisions, and finally

(*e.*) The division poultry and dogs.

To these divisions all foreign countries can contribute.

The essential success of the exhibition through its international divisions depends to a great extent upon a numerous participation from foreign countries.

I beg leave to ask you to call, by means of an item in your esteemed journal, the attention of those in the United States to this exhibition, in whose interest it would be to participate.

I have the honor to be, Sir,

Yours most respectfully,

The Consul of Austria and Hungary, at New York.